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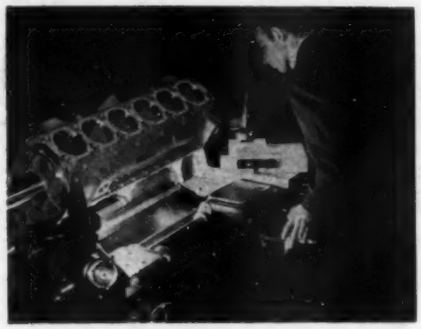
AMERICAN MACHINIST

May 28, 1941



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WHAT'S IN THIS ISSUE

POWER FOR THE ARMY

Business is better than bombs with which to defend Democracy, provided we have bombs and get down to business. It is almost axiomatic that the U. S. must gain a military supremacy, particularly in the air, if it is to survive. Out at Farmingdale, Long Island, Ranger Aircraft, subsidiary of Fairchild Aircraft Corporation, is feverishly building airplane engines. The company is doing yeoman service to provide more motor power for the U. S. air arm. Specifically, Ranger is building a six-cylinder, in-line direct-drive engine which is inverted and air-cooled but not supercharged; it will be used in training planes by the U. S. Army Air Corps. The entire production story is described in this issue's Armament Section which begins with a delineation of the crankcases used in the engines. All this is discussed in "Power for Army Trainers," on page 487.

SAGA OF A SAG

The Institution of Production Engineers, London, England, has been working around the clock to develop new standards for the testing of machine tools. Of this subject there has been considerable discussion in English metal-working papers, including *The Machinist*. Dr. George Schlesinger, director of the institution since 1938, analyzes in this issue of AMERICAN MACHINIST the time-honored method of using test mandrels to check up on machine tools. Although the mandrel is one of the most widely used inspection tools in the manufacture of new machine tools and in the repair of old ones, Dr. Schlesinger indicates that it has a "natural sag" which, when not taken into consideration, causes trouble. Dr. Schlesinger, who knows all about diseases of tools, discusses this one and tells how it may be cured. Before he became a full-fledged machine tool medico, he served many years as professor for production engineering at Brussels University. He also served as a machine tool designer, a shop and chief engineer, and as head of an apprentice school. The titular designation of "Doctor" was awarded at Brussels. His article on "The Natural Sag of Test Mandrels" is just what the doctor ordered. Part I begins on page 473.

A. H. PREY

DR. GEORGE SCHLESINGER

TOOL GRINDER SERENADE

Breathes there a tool grinder with soul so dead, who never to himself hath said, "Hey, give me a hint! How do I fix this in a hurry?" In all likelihood there has been such a fellow in your shop at some time or other. Because A. H. Prey, of the Carborundum Company, knew this, he wrote "Angles on Tool Grinding." For the remedies to your problems turn to page 480.

METAL THICKNESS

Although the daily news accounts of stock prices may help speculators to judge somewhat which stock is the best and which not so good (there are many arguments to the contrary), any investor would give his first million for a foolproof measuring device. Similarly, since the advent of electroplating metals, many methods have been used to help in the determination of the thickness of metal deposits. But contends Raymond F. Yates, who knows about such things, these methods cannot take the place of measuring instruments which are used and approved by the plating profession. In Part IV of his article "Hard Chrome for Tougher Tools," which begins on page 477, Mr. Yates tells all about it.

DIE MANUFACTURE

Although many words have been written on die design, precious little has been said about the actual manufacture of dies. For a quick course in grinding, drilling, templets and lining up parts turn to page 503 for the Reference Book Sheet written by Albert Huff.

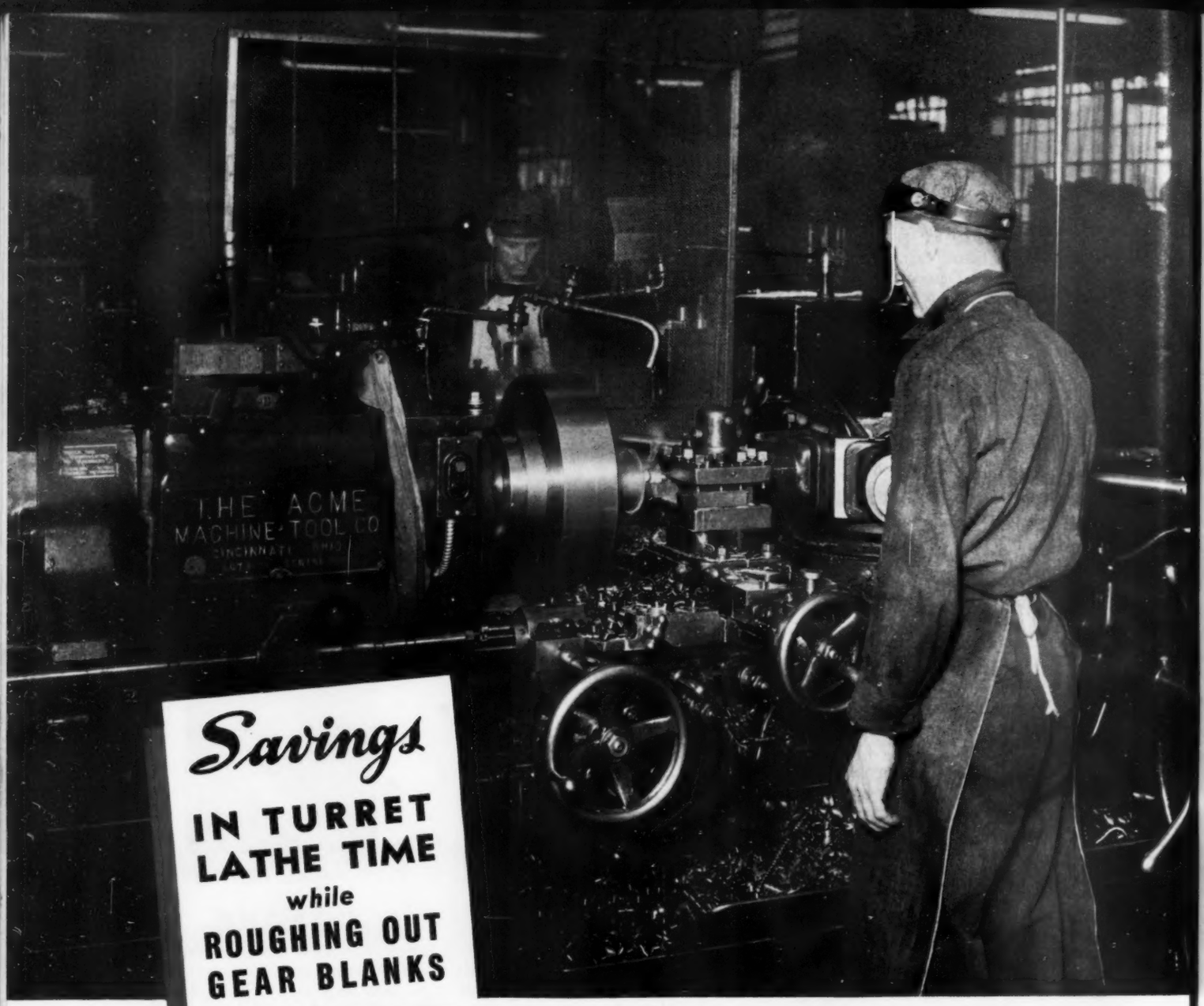
ALBERT HUFF

COMING

Boring machines will do other jobs, such as facing, threading, turning and counterboring, as will be described in an early issue of AMERICAN MACHINIST by G. D. Stewart, chief engineer, standard machinery, The Ex-Cell-O Corporation. In the same issue, L. B. Jennings, manufacturing engineer of Westinghouse Electric & Mfg. Company, will tell how to use powdered metal cakes to secure better radiographs. Sometime within the next month the story of the production of Allison's liquid-cooled engine will be told in a new Armament Section.

FLAME-HARDENING

Continuing our policy of carrying on a comprehensive serial along with our regular short articles, we are beginning with our issue of June 25, a series of articles on flame-hardening. The economic advantages of the process will be stressed and the author, J. G. Magrath, applied engineering division, Air Reduction Company, will tell how to apply it.



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ESTABLISHED 1877 **AMERICAN MACHINIST** BURNHAM FINNEY, Editor

Natural Sag of Test Mandrels

BY DR. GEORGE SCHLESINGER, THE INSTITUTION OF PRODUCTION ENGINEERS, LONDON, ENGLAND

I—Whether supported at one or both ends, test mandrels have sufficient natural sag to make inspection results questionable where allowances are not made

THE RESEARCH DEPARTMENT of the Institution of Production Engineers has investigated the influence of the natural sag of test mandrels upon test results when used to check alignments of machine tools. This sag frequently is not taken into consideration and causes trouble which can be avoided, when the characteristics of solid and hollow mandrels are known and used in the interpretation of alignment tests. Of these tests, the "axis to axis" and the "axis to plane" inspections are the most frequent examples. To find rules which could be commonly accepted, the following three taper-shank mandrels were inspected: (1) a 1-in. diameter and 12-in. long solid mandrel, (2) a $2\frac{1}{2}$-in. diameter and $21\frac{3}{4}$-in. long solid mandrel, and (3) a hollow mandrel of the same external dimensions as the larger solid mandrel.

The small mandrel was first tested in V-blocks on a carefully levelled surface plate as shown in Fig. 1. Measuring instrument employed was a dial gage reading to 0.0001 in. per division, with a straight-line calibration curve. The nominal tolerance for reading was the usual one of ± 0.2 division (± 0.00002 in.), but it was found in practice that the gage could hardly be relied on to anything better than ± 0.5 division (± 0.00005 in.). For all of the readings, the plunger of the dial indicator was displaced from its position of rest by an amount corresponding to approximately three revolutions of the pointer (0.03 in.), and the plunger pressure was about 3 oz.

It was found that: (a) the cylindrical portion of the mandrel was accurate within 0.0001 in. at any point, (b) no "out of round" could be detected, and (c) the top surface of the mandrel was dead level (i.e., no variation in the height above the surface plate could be detected with the dial gage).

The taper portion showed a maximum deviation of three divisions (0.0003 in.) on its full length. This error was such as to cause an inclination, Fig. 2, between the center line of the taper portion and that of the cylindrical portion. The taper itself was dead round at all positions along its length. Consequently, the mandrel could be considered fairly accurate.

To determine the sag of this mandrel, a ground bushing with a taper

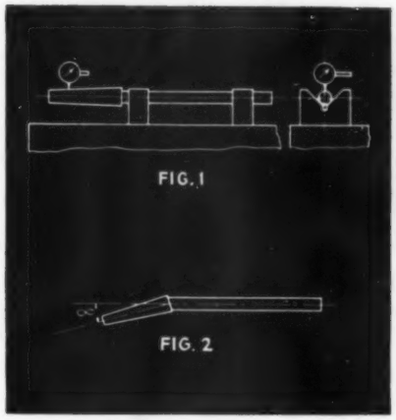


Fig. 1—This set-up was used for checking the small solid mandrel with a dial gage. Fig. 2—Deviation between the axis of the taper and the axis of the cylinder on a faulty mandrel

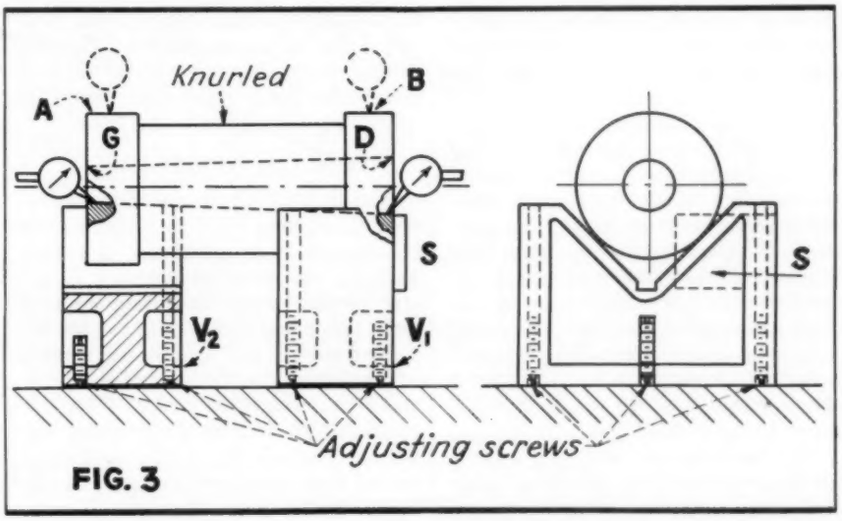


Fig. 3—Set-up for checking cylindrical bushing with taper hole. V-blocks are adjustable. This set-up also was used for taking indicator readings to measure sag due to weight of mandrel

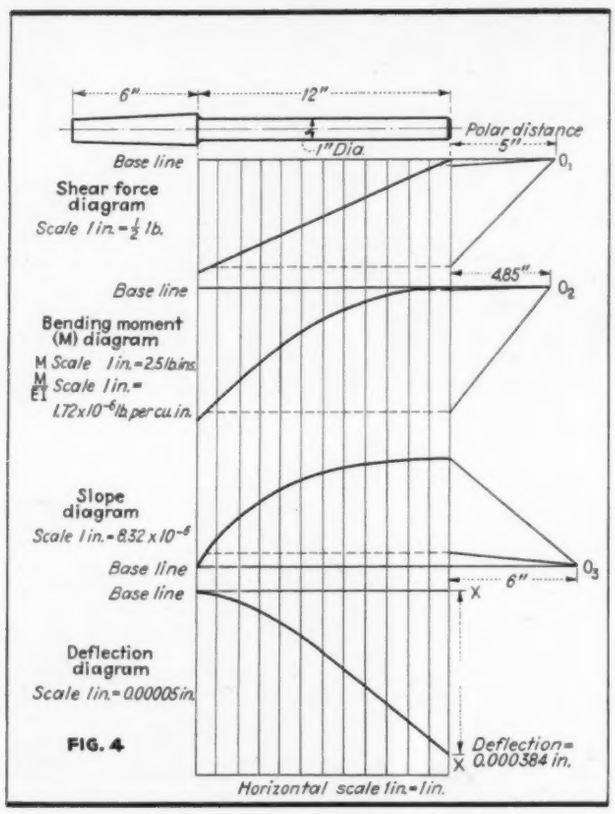


FIG. 4

Fig. 4—Natural sag of the 1-in. diameter, 12-in. long solid mandrel was calculated graphically, using the Mohr theorem, upon a 12-in. long base line

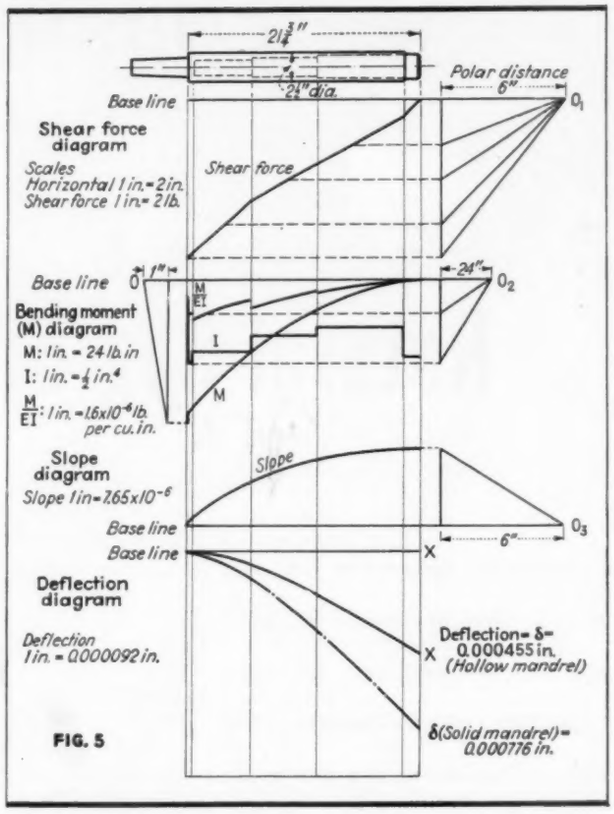


FIG. 5

Fig. 5—As in Fig. 4, graphic determinations of natural sag were made for the 2½-in. diameter, 21¾-in. long solid and hollow mandrels

bore and an outside diameter of about 2.9364 in. at *A* and *B* (Fig. 3) was used as a main bearing. The internal taper was finished so as to mate accurately with the tapered end of the mandrel. The bushing was inspected in V-blocks, V_1 and V_2, placed on a surface plate. The external cylinders at *A* and *B* showed deviations from the round of about 0.5 division (0.00005 in.) when turned slowly. The internal diameters were measured at *C* and *D* in the same set-up. Axial movement was prevented by giving the bushing constant axial pressure against the rigid stop *S*. Readings at *C* and *D* showed the bore to be dead round (any variation was not measurable with the gage used). Concentricity of the taper bore and the outside cylinders *A* and *B* was checked with a Newall measuring machine and found to be exact; the diameters at *A* and *B* were also measured with the following results: Cylinder *A* out of round 0.00006 in., Cylinder *B* out of round 0.00010 in.

This bushing was used as a bearing for the taper-shanked cylindrical mandrel, being supported by the same cast iron V-blocks, the height and inclination of which could be adjusted by three screws, as shown in Fig. 3. The adjustable V-blocks were necessary to bring the theoretical axis of the mandrel parallel with the surface plate. To provide a reference line for horizontal adjustment of the mandrel, a hardened and ground straightedge was clamped to the surface plate. The stand for the dial gage was pressed against this straightedge, so that a vertical and a horizontal reference plane was provided for all measurements. The V-blocks were clamped to the surface plate after their adjustment in both measuring planes was completed.

Sag Can Be Calculated

The natural sag of the 1-in. diameter, 12-in. long mandrel placed in the bushing could be calculated, as a free hanging cantilever of constant diameter loaded by uniform weight has a deflection equal to $Wl^3/8EI$, where W = weight per unit length, l = length of cantilever, E = modulus of elasticity, and I = moment of inertia. This calculation was made by the ordinary deflection formula for such a uniformly loaded free cantilever and graphically by using the Mohr theorem, Fig. 4. For the latter a base line 12-in. long was drawn and the maximum shear force calculated. The shear force is zero at the free end and increases uniformly to a maximum (equal to weight of free portion of cantilever) at the fixed end. This enabled the *shear force* diagram to be drawn.

The base line was divided into twelve equal sections and the points where the shear force graph passed through the center of each section were found. A suitable pole O_1 was taken, for convenience, at the right-hand side of the base line. The points found above were then projected to the vertical axis of the polar diagram and joined up to the pole.

Next lines parallel to the lines in the polar diagram were drawn across the appropriate sections, starting at the free end, and each line beginning where the preceding one ended. The mid points of these lines were joined up and were found to form a smooth parabolic curve.

Now, if a shear force diagram is integrated, we get a *bending moment* (*M*) diagram. The process of drawing a polar diagram is merely a process of graphical integration. But, in doing so, a constant of integration is introduced. Thus it was necessary to find the position of the base line. As the bending moment *M* at the free end of a canti-

lever is zero, the base line was drawn so that this condition was fulfilled.

In order to get the *slope* diagram in Fig. 4, it is necessary to integrate the *M/EI* diagram. But, since the moment of inertia was constant the *M/EI* diagram was the same as the *M* diagram, measured on a different scale. This diagram was integrated in the same way as the shear force diagram, but the base line occurred in a different position, since slope was zero at the fixed end.

Slope Diagram Integrated

The slope diagram then was integrated in the same way to give the *sag curve* in the deflection diagram. Again the sag was zero at the fixed end, so the base line was fixed to fulfil this condition. The *sag* or *deflection* was then found by scaling off the distance X–X and multiplying by the appropriate scale (see below) to get the result in inches. A similar set of diagrams was developed for the 2½-in. diameter solid and hollow mandrels as shown in Fig. 5.

Bending moment (*M*) scale equals length scale multiplied by shear force scale multiplied by pole distance of shear force diagram.

(*M/EI*) scale equals *M* scale divided by (*EI*), with *E* equal to 30,000,000.

Slope scale equals (*M/EI*) scale multiplied by length scale multiplied by pole distance of bending moment (*M*) diagram.

Sag or deflection scale equals slope scale multiplied by length scale multiplied by pole distance of slope diagram.

The deflection of the 1-in. diameter, 12-in. long solid mandrel was then worked out by direct calculation and the same result (sag = 0.0003835 in.) obtained. This parabolic deflection curve next was used to set up the real axis of the cylindrical part of the mandrel in the bushing on the surface plate.

The adjusting screw in the V-blocks were set so that the axis of the taper was horizontal and the mean difference in height between the fixed and free ends of the mandrel was approximately 0.000384 in. To find the correct curve, dial indicator readings were taken at each 2 in. along the axis. Required readings were made in four positions of the mandrel, which was rotated 90 deg. between each set of readings. Readings were made twice, first from the bushing to the free end and then in reverse order. The upper graph in Fig. 6 shows the deviations of all these points from the theoretical deflection parabola. Maximum single deviations were ±0.00013 in. and mean deviation was ±0.000025 in. This mean deviation was within the limits of the dail gage of 0.0001 in. per division. Maxiumum real deviations were not more than one division. Coincidence of calculated and measured deflection is excellent.

A cross check was made by trying to adjust the axis so as to distribute the natural sag equally above and below the horizontal axis. This could be done, Fig. 7, because the heights of the V-blocks supporting the main bushing were adjustable. If the mean position of the axis of the cylindrical mandrel was to be approximately horizintal, the natural sag had to be distributed symmetrically above and below the theoretical horizontal axis as shown in the lower graph in Fig. 6. This has been proved by the readings given in the four positions of the mandrel. They show in all cases that the sag prevents a full horizontal line, but the axis of rotation for the bushing which may represent, for example, the main bearing of a lathe or milling machine, was inclined 0.0006 in. This counter check proves again that if the main spindle is horizontal, the sag of the mandrel is at least 0.000384 in. Generally it is much more because accurate bearings and mandrels, such as were used, are not always available.

In the next test, the small solid mandrel was loaded with a weight of 3 lb. (corresponding to the ordinary cast iron bushing of a milling arbor) as indicated in Fig. 8. The weight was 3¼ in. long and the dial indicator used was set to the extreme end of the mandrel. The weight of the bushing on the sagging mandrel caused an added deflection of 0.0014 in. The total deflection of the mandrel thus was 0.0014 in. plus 0.000385 in., or 0.001785 in. The permissible error in testing the alignment of the bore of an arm bracket with the milling cutter spindle is 0.001 in. per ft. It is obvious that if the natural sag of the mandrel increased by

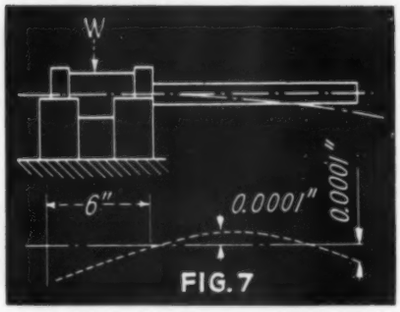


Fig. 7—By adjusting the supporting V-blocks, the natural sag of the mandrel can be distributed equally above and below the horizontal axis

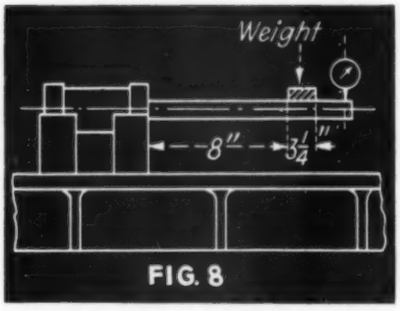


Fig. 8—Deflection of the test mandrel sometimes is doubled by the addition of a weight corresponding to the weight of a slip bushing

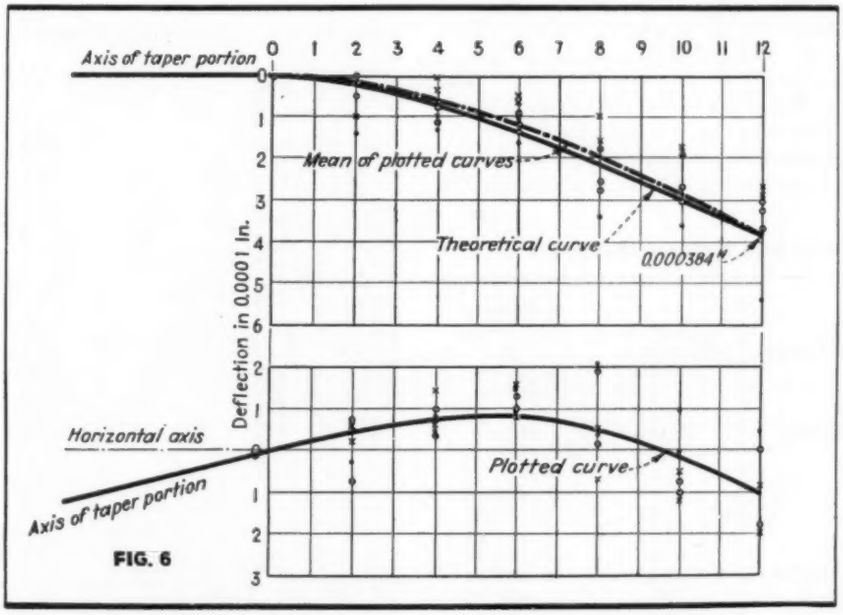


Fig. 6—Deviations of actual sag of 1-in. diameter, 12-in. long solid mandrel from theoretical curve are indicated in these graphs

the weight of the slip bushing is about 0.0018 in., it is difficult to measure the correct alignment by this method.

Finally, the 3-lb. weight was replaced by one of 21 oz, corresponding to an aluminum alloy bushing, such as might be used for checking mandrels. This added weight caused a mean added deflection of 0.00065 in., giving a total sag of 0.001035 in. Thus if a bushing of aluminum alloy or magnesium is used when checking overhanging arms by the slip bushing method, the effect of its weight, though considerably less than that of other types, is still not to be neglected, even with short arbors. For long arbors weakened by keyways, the result is unfavorable for the bushing method.

Sag Must Be Known

These tests also were made on a Cincinnati horizontal milling machine with a $1\frac{1}{4}$-in. diameter taper-shank arbor having a 20-in. long $\frac{3}{16} \times \frac{3}{32}$-in. keyway, and using a standard $2\frac{3}{8}$-in. diameter, 4-in. long standard cast iron bushing weighing 50 oz. The deflection of this arbor, shown in Fig. 9, due to the bushing was 0.0027 in. In such a case, using the ordinary milling arbor and bushing, the real deflections must be known and carefully taken into consideration, or else the measurement is wrong and the bracket is not aligned. This misalignment may cause considerable heating of the front end of the arbor while in use.

The I.S.A. standard solid mandrel, $2\frac{1}{2}$-in. diameter, and $21\frac{3}{4}$-in. long, shown in Fig. 10, used for these tests had a No. 5 Morse taper which is only 1.75 in. diameter at the large end. Therefore, the major diameter of the taper was smaller than the diameter of the mandrel itself. This is unsatisfactory from the point of view of deflection, but these are the standard dimensions. The design of the mandrel shown in Fig. 9 with a relatively large tapered section is better from a design standpoint. Sag of the solid $2\frac{1}{2}$-in. diameter, $21\frac{3}{4}$-in. long mandrel was calculated to be 0.00078 in. and this was checked as correct by the graphical construction shown in Fig. 5.

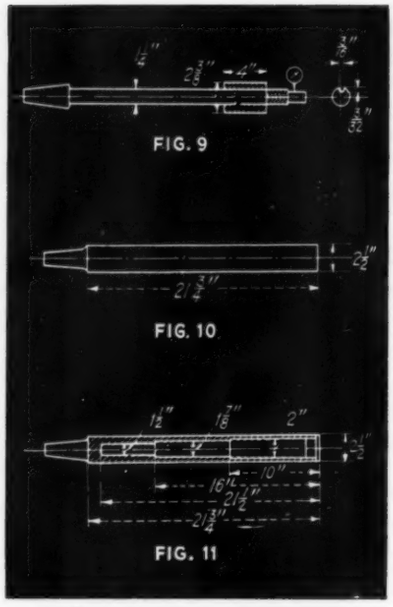


Fig. 9—Deflection caused by the bushing on this mandrel measured 0.0027 in. when the dial indicator was placed at the free end. Fig. 10—Tapered shank on this I.S.A. standard solid mandrel is smaller than the cylindrical body. Fig. 11—Sag of this hollow mandrel is 0.000455 in., which compares with a sag of 0.000766 in. for the solid mandrel of the same size

The I.S.A. standard hollow mandrel shown in Fig. 11 also has an outside diameter of $2\frac{1}{2}$ in., is $21\frac{3}{4}$ in long. With this mandrel the calculated sag is 0.000455 in. as shown in Fig. 5. The construction of the deflection diagram shown in Fig. 8 is self explanatory, the main difference between the solid mandrel diagram and the diagram for the hollow mandrel consists in the sudden changes caused by the internal stepped bore of the hollow mandrel. The accompanying table shows the dimensions and calculated deflection or sag of solid and hollow mandrels of various sizes.

In the second part of this article, Dr. Schlesinger will discuss practical methods of eliminating the errors which may occur because of natural sag.

Calculated Deflections of Solid and Hollow Mandrels

Outside Diameter, Inches	Inside Diameter, Inches	Total Length, Inches	Length of Measuring Position, Inches	Calculated Deflection at Measuring Position, Inches
$\frac{5}{8}$	Solid	$5\frac{7}{8}$	$5\frac{1}{8}$	0.000050
1	Solid	$9\frac{7}{8}$	$9\frac{1}{8}$	0.000167
1	$\frac{3}{4}$	$9\frac{7}{8}$	$9\frac{1}{8}$	0.000120
1	Solid	12	$11\frac{7}{8}$	0.000384
$1\frac{5}{8}$	Solid	$14\frac{3}{4}$	$13\frac{3}{4}$	0.000314
$1\frac{5}{8}$	$1\frac{3}{8}$	$14\frac{3}{4}$	$13\frac{3}{4}$	0.000226
$2\frac{1}{2}$	Solid	$21\frac{3}{4}$	$20\frac{1}{2}$	0.000776
$2\frac{1}{2}$	Fig. 11	$21\frac{3}{4}$	$20\frac{3}{8}$	0.000455

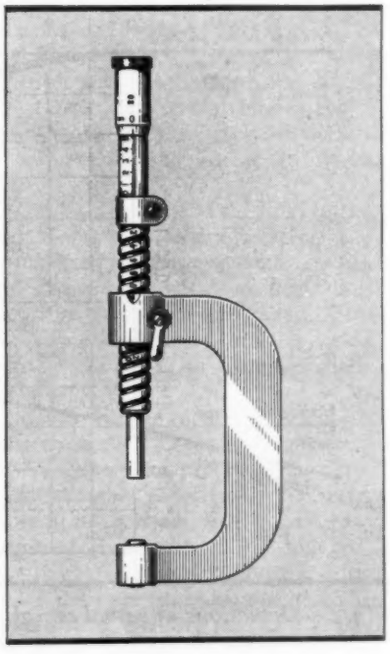
Accuracy in the Eighties

By TOM ADDISON, ENGINEER
The Cincinnati Planer Company

INCLUDED AMONG THE TOOLS of one of our foreman is an interesting micrometer shown in the accompanying sketch. Made by A. J. Wilkinson & Company of Boston and patented in 1883, it still maintains its original accuracy when tested with gage blocks.

Its range extends from zero to slightly more than three inches in width but not quite three inches for round work. This range is obtained in two steps, each of one inch by adjusting the coarse lead support screw threaded in the frame, and in which the spindle is rotated. The support screw has a V-thread of $\frac{1}{5}$ in. lead and is stamped as shown, the nut being split to permit locking the screw.

Inside this support screw is the spindle having 50 threads per inch; hence the divisions on the thimble run from 0 to 20. This differs from present-day micrometers having an adjusting screw of 40 threads per inch and thimble divisions running from 0 to 25.



How Thick a Plate?

BY RAYMOND F. YATES

Measurement of chrome deposits is vital in maintaining quality when durability rather than fine appearance is the real objective

HARD CHROME PLATING has brought with it the vital need for fast and accurate methods of measuring the thickness of deposits. It has also been found advisable to devise tests wherein the nature and quality of various electroplated metals, including chromium, may be determined with ease and without great expenditure of time.

The nature of the deposit plated on any kind of a surface depends upon a number of variables, and a surprisingly large variation in the quality of the deposited metal may take place. As an instance, the hardness of the plate may run all the way from 140 to 630 on the Vickers-Brinell scale when the measurements are made with the diamond ball indenter. Even with all variables under good control during the plating operation, considerable difference in hardness will be demonstrated.

The plater of hard chrome will want to have at least one reliable method of measuring the thickness of deposits at hand. Several charts have been made available whereon the rate of deposit for given bath temperatures and current densities are given, but such methods of computation leave much to be desired. Perhaps, like charts on the stock market, they may help one's judgment; but they cannot take the place of actual measuring instruments or methods that have been approved and used by the plating profession.

Special microscopes and accessories have been devised for this sort of work but the testing period is comparatively long (fifteen minutes) and the cost of the instrument is high, running around $300. A high degree of skill is required for the operation of the device. The article bearing the deposit must be cut, mounted, polished, etched and placed upon the stage for actual measurement. The talent capable of doing this chore is not usually found around toolrooms or plating shops.

Some years ago Mesle introduced a method for measuring thicknesses which has since come into wide use. It is simple, fairly accurate and requires no particular skill and no expensive equipment. This has become known as the chord system. In it a grinding wheel or file is used to cut through the deposited metal. The width of the resulting gash is a measure of the chromium thickness. The wheel is used to cut the chord on flat surfaces, while the file is used to cut it on curved surfaces. Where files are called upon to cut through heavy deposits of chromium, however, it may be advisable to use some sort of good abrasive material in bar form.

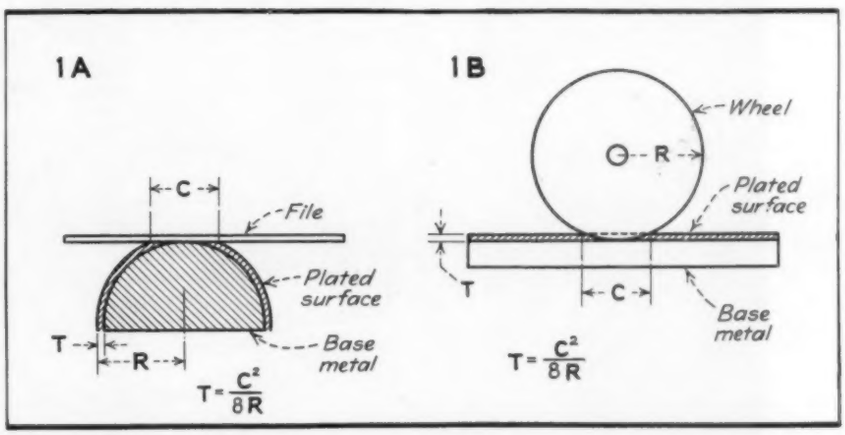
Figuring the Thickness

In the use of the test, either the grinding wheel or the flat abrasive is applied until the deposited metal has been cut through, barely exposing the base metal. The less the exposure of base metal the better. This accomplished, the length of the cut is carefully measured with a scale. The radius of the grinding wheel or of the part is known. Hence all of the factors are available for the following simple formula:

$$T = \frac{C^2}{8R}$$

While this method is not quite as accurate as the microscope method, it is good and certainly to be recommended for deposits above 0.0002 in.

Deposits of chromium that range under 0.0002 in. are not suitable for the microscope method either, but a fair degree of accuracy may be had with a chemical "yardstick." This involves dropping undiluted HCl (hydrochloric acid) on the deposit and timing the resultant gassing carefully. The single drop is applied with a medicine dropper and both the article to be tested and the acid should be reasonably close to 70 F. Each second of time, from the beginning to the end of the gassing, is equivalent to one-millionth of an inch.



In the chord system of measurement the deposit is ground or filed off until the base metal is exposed. It can be used on a test piece or where there is no objection to damaging a small area of the plating

A paraffin cone prevents the acid from spreading.

During the past year or so, a new and highly commendable method of measuring the thickness of non-magnetic metals on magnetic base metals has made its appearance. The instrument may now be secured for about $150. The device may be speedily applied to measuring operations, results being made almost immediately available once the sample to be tested has been placed on the instrument table. Another thing in the favor of the device is that measurement does not destroy or in any way mark the sample under test.

Magnetic Method

The Aminco-Brenner "Magne-Gage" as it has been called is capable of reaching down as far as 0.0002 in. with a ± of 10 per cent, which is considered very good in this difficult field. This gage can be used to measure deposits running as high as 0.025 in. in thickness. This represents about the limit in chromium deposits at this time.

This method is based on the decrease in magnetic attraction resulting from the interposition of any non-magnetic material between a magnet and a magnetic base. A magnet exerts its maximum attraction when it is in direct contact with iron or steel. If any non-magnetic material, such as zinc, copper, chromium, enamel, etc., is placed between the magnet and the steel, this attractive force is decreased to an extent depending on the thickness of the intervening layer. If a device with a permanent magnet is calibrated with non-magnetic coatings of known thickness on steel, it can be used to measure the thickness of other coatings.

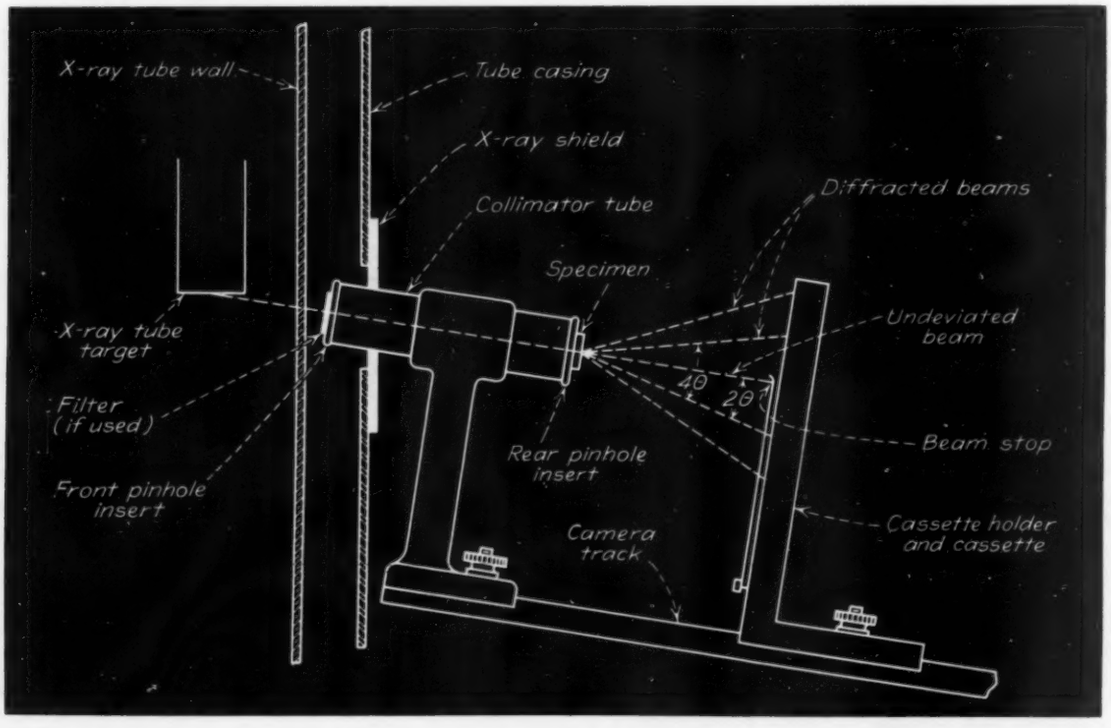
In this method, a large attractive force corresponds to a thin coating and vice versa. The dial of the gage is set to read zero on bare steel and above 100 in the absence of magnetic material. By this method of setting the dial, larger dial readings correspond to thicker coatings.

Quite recently special X-ray equipment has been designed for the purpose of investigating chromium deposits of all kinds through the medium of diffraction. The apparatus involved, for X-ray examination at least, is comparatively simple and it bids to greatly extend knowledge of heavy chromium deposits. To date, it has not only confirmed the findings and theories held by various authorities but it has added rather extensively to the store of experimental and research data at hand. It is the first method perfected actually to determine the nature of the deposit. With the increased use of hard chrome plating in the defense program, X-ray examination appears destined to serve in an important role. Chemical and ordinary metallurgical testing is now augmented to a point where complete investigation of deposited surfaces can be made. It actually reveals the structure of the applied metal.

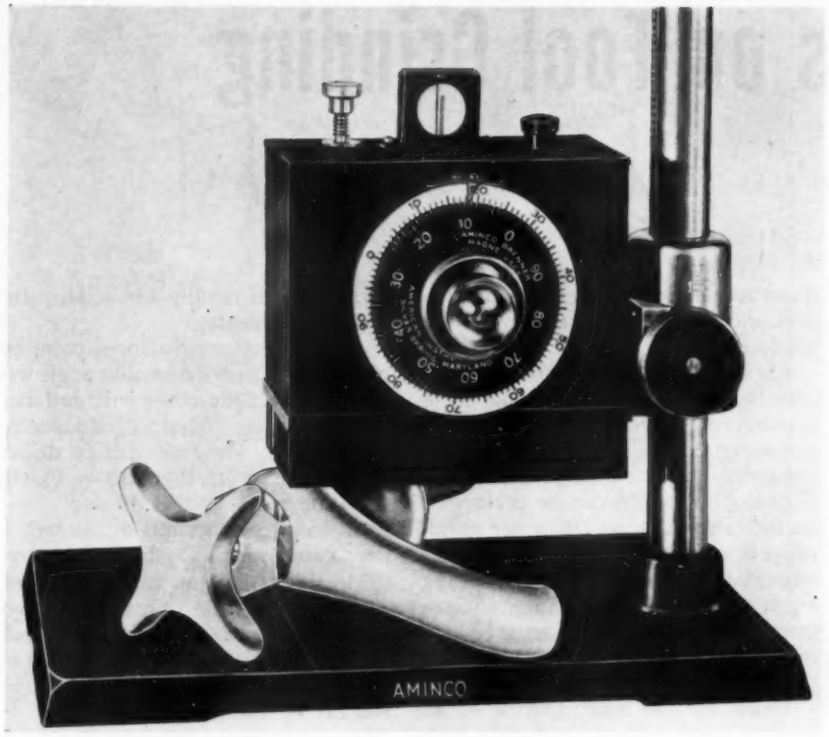
Equipment for X-ray Test

X-ray beams change their direction when passing through metals. Repetitious and identical groups of atoms throughout crystalline forms (as in the case of chromium) from three-dimensional diffraction gratings. These affect X-ray beams in much the same manner as an optical grating affects a beam of visible light. Thus when a small beam of X-ray generated by a small tube is permitted to strike a sample of chromium-plated metal at a definite angle, the rays are diffracted and the record of their diffraction is left on a photograph plate. The apparatus used is shown diagramatically. As used later it was provided with a universal specimen mount wherein a system of cradles permits the operator to interpose the face of the specimen in the X-ray beam so that proper incidence is obtained. A small microscope mounted on the back of the simple camera can be used to check specimen placement so as to facilitate and quicken testing time. A further perfection of the instrument involves a special cam mounting for specimens whereby the piece under examination can be oscillated through a pre-determined angle.

Some idea of the sensitivity of this method of examination may be had



This X-ray diffraction equipment measures chromium deposit thickness without harming the specimen. But only flat, tiny parts can be handled, and the method requires photographic facilities



Thickness of chromium plating on any magnetic part can be determined without damaging the surface with this Aminco-Brenner "Magne-Gage"

from the following experiment conducted by J. T. Wilson of the diffraction laboratory of the General Electric X-Ray Corporation. In this work four identical pieces of steel were plated in a closely controlled chromium bath. The temperature varied a few degrees for each test piece; 50, 52, 56, and 60 C. were used. In each instance a current density of 35 amperes per square decimeter was used.

Subsequent examination of these pieces, made in rapid succession by mounting the specimens closely together, showed that considerable difference in pattern was noticeable. Naturally, the difference in the X-ray results was brought about by variations in construction imposed by the slightly varied temperatures used in the plating operation. The experiment emphasized the great need for chromium bath control of both temperature and constitution if uniform results and uniform chromium surfaces are to be deposited.

In the test mentioned above, the chromium deposited at 56 C. was shown to have the greatest wear resistance. This should not be taken as a guide, however. The specimen was simply the best of the four.

Practical Personnel Relations in a Small Shop

WHAT CIRCUMSTANCES are responsible for an average labor turnover of less than half of one per cent during the past ten years. This is the record of a Midwest tool and die jobbing shop that employs less than 100 men.

First of all, the plant is purposely kept small enough so that complete control is exercised by one man—the sole owner. This man has an abiding sense of responsibility toward his men. He expects a living for himself and for every employee, and positively refuses to be a party to chiseling tactics. Those who offer a large contract in return for cutting the rate in slack periods are invariably turned away. While the shop is operating, the men receive an average of $1.40 per hour and are allowed to work as much as 68 hours per week, time and one-half being paid for hours in excess of 44. As a result, the men make over $3,000 during a seven-month season. Second and third shift operation is definitely avoided. The shop does not work on Sunday.

The plant is kept clean and modern in every respect. Self-respecting workmen keep themselves clean, likewise their machines and adjacent working space. The proprietor sees that washrooms are maintained spotless, provides awnings to keep out the glare of the sun through large window areas. Water coolers have extra space for men to keep lunches and milk on ice. Soft-drink dispensing machines are available. Fans on the overhead gas-fired unit heaters are kept running on warm days to stir up the air. A fenced parking lot protects employees' automobiles. Equipment is maintained in first-class condition and is replaced whenever a new machine will pay for itself in two years. Operators appreciate the time-saving features of conveniently grouped controls and wide speed and feed ranges on up-to-date machines. Furthermore, machines are ordered with such attachments and accessories that will permit the widest number of operations in one set-up, avoiding waiting for another machine. For example, all shapers have universal tables so that angle cuts can be made without going to another unit.

Accurate pricing of work is another reason for employee satisfaction. Both the proprietor and his superintendent are able to figure costs accurately, in contrast to many jobbing shops. Thus, there is no need to chisel on wages or quality in order to come out even or make a profit. Customer acceptance has been built up for good work at the right price. In consequence, the men work a full season year after year. Furthermore, they get the highest grade of die and tool work, which is important to high-grade mechanics.

Craft unionism was definitely encouraged by the manager, who saw to it however, that the best interests of the men were protected when writing the contract. For example, seniority was flatly rejected on the ground that the best men should be laid off last. Surprisingly enough, the business agent agreed to the principle that among skilled men, those who make the best use of their talents should have the opportunity for longest employment. On the other hand the Business Agent had proposed that wage rates fluctuate with the condition of business. To this the manager replied that such a clause opens the way to wage chiseling.

In this shop, there is a certain amount of practical paternalism. This may range from providing free beer for the company picnic to paying all medical and hospital expenses for men and their families requiring surgical treatment of any kind. Despite high annual wages, skilled workmen find such expenses to be onerous. The business pays enough, because of the way it is run, to take care of these outlays. It is impossible to hire men away from this shop.

Angles on Tool Grinding

BY A. H. PREY, THE CARBORUNDUM COMPANY

How a tool is ground affects its life, its efficiency and the quality of the product. A few minutes of care in the tool room may save hours in the shop

WHEN SHARPENING most metal-cutting tools, the best rule to follow is to grind so as to maintain the original angles of the tool. In general, it is well to remember that a thin-edged tool has the advantage of cutting more easily than one having a thick edge; it generates less friction, causes less distortion of the chips and facilitates their removal. However, the edge must be thick enough to stand up under the cuts and speeds to which the tool will be subjected. The angles must turn the chip properly and still preserve the cutting edge. Changes in material being cut or in the manner of cutting often necessitates changes in the cutting angles employed.

For lathe and planer tools, the lip angle ranges from 40 to 50 deg. for steel and wrought iron, and from 60 to 75 deg. for cast iron. In a production shop it is essential, and in a small shop desirable, to sharpen lathe and planer tools uniformly. This is most easily done with special tool-grinding machines.

The advantages of a tool-grinding machine are that it saves the operator's time, gives correct cutting angles easily by angular adjustment of the chuck, increases the life of the cutting tool, reduces tool inventory, increases production and improves the quality of the product.

For offhand sharpening, the machine may be either a bench or floor-stand grinder, or a wet tool grinder. By mounting a coarse and a fine grit wheel on a dry grinder, both roughing and finishing operations can be performed on the same machine. Whether grinding wet or dry, it is essential that the wheel be kept running true and cutting freely by frequent dressing. When grinding offhand, the tool must be kept moving continuously across the face of the wheel.

Drills are the most difficult of all tools to grind properly by hand. Tests of hand-sharpened against machine-sharpened drills show startling contrasts. On the average each machine-sharpened drill will produce about twenty times as many holes as will hand-sharpened drills. As would be expected, drill cost per hole is in about the same ratio—$2.20 per thousand holes against eleven cents for machine-sharpened drills.

What to Look For

The most common faults of hand-sharpened drills are:

1. Incorrect relief—If too small a relief is used, the drill will not cut; if too great, it will dig in. Relief should be about 7 deg. at the periphery. If the relief is unequal, the lip will chip or the drill will split.

2. Cutting lips of unequal length—If the lips are unequal in length, the drill will produce over-size holes. One lip will do all of the cutting and, therefore will dull rapidly and require frequent resharpening.

3. Incorrect or unbalanced point angle—the lip with the smaller angle will do the work; the other will dull rapidly, requiring frequent resharpening of the drill. The hole will be drilled oversize. Each lip should have exactly the same angle, usually 59 deg.

4. Incorrect thickness of the web at the chisel edge—If the web is too thick, power consumption will be excessive; if it is too thin the edge will be weakened and the drill will break. Reducing the thickness of the web by "point thinning" should not be carried too far up the web. Care should be taken to maintain the exact center of the drill. The web thickness at the chisel edge should be about an eighth the thickness of the drill.

The first operation in sharpening a drill is to produce the cutting edge. This develops the relief and clearance point angle. Next thin the chisel edge by grinding a groove on each side of the web between the cutting edges, using a round-faced wheel. It can be done offhand, but better results will be secured by using a machine that has fixtures for holding the drill properly. Common drill grinding faults are indicated in Fig. 1.

Broken drills can be salvaged by cutting off the broken part with a thin abrasive cutoff wheel, then grinding the new point as when resharpening.

Usually only the chamfer at the point of a tap gets dull and needs resharpening. This is done by grinding the chamfer and the relief back of the cutting edge along the chamfer. If prop-

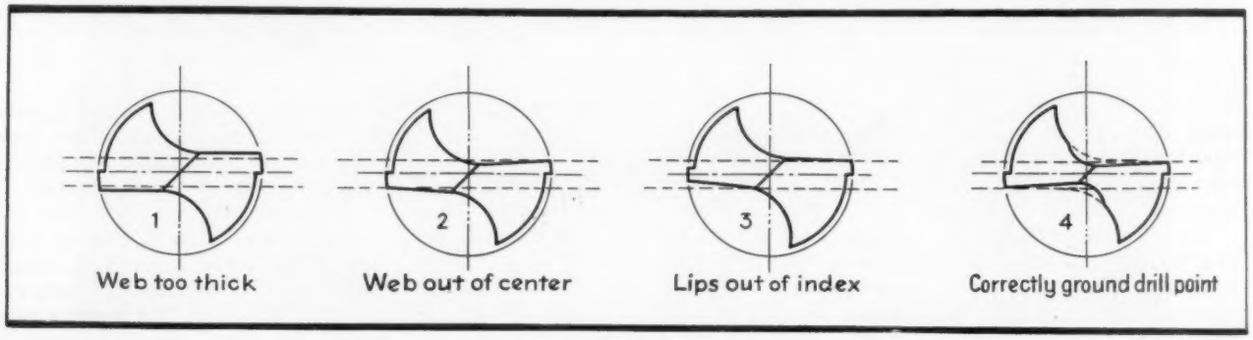


Fig. 1—Common drill grinding faults are indicated above. Machine-ground drills are more accurate than hand-ground drills and produce holes at a twentieth of the cost

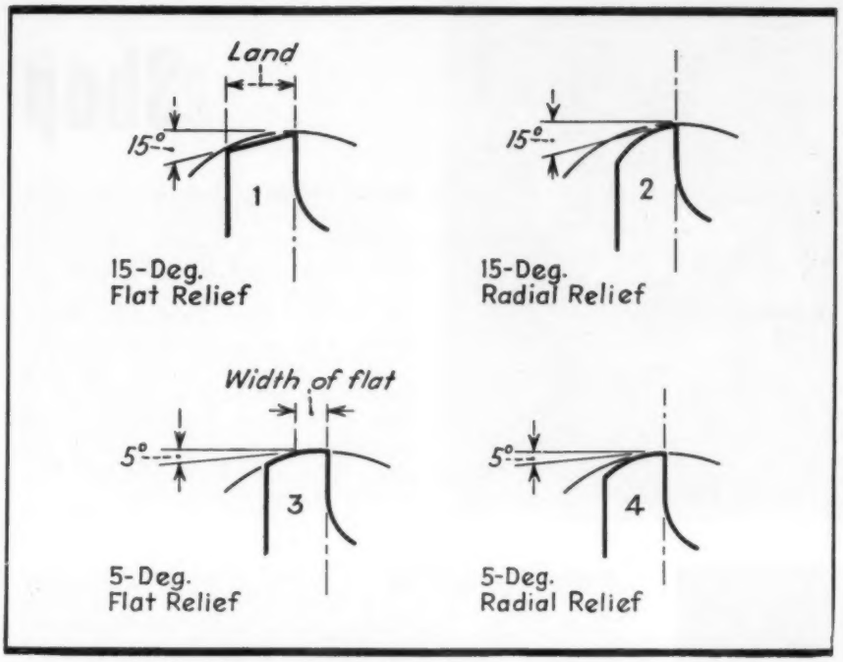


Fig. 2—Relief angles are important on taps. Usually a 5-deg. radial relief is best

erly done the flutes ordinarily need not be ground.

It is important to keep the length of the chamfer correct. On hand taps the chamfer generally includes four or five teeth. Chamfer is almost non-existent for bottoming taps, short on plug taps and long on nut taps. Unless each flute has exactly the same angle of chamfer, the tap will not start true. The accuracy of the grinding can be checked by turning the tap two-thirds through a nut. If the lands are not all at work, inspection quickly will make this plain.

It is important that the relief be correct. In Fig. 2 is shown a tap with a 15-deg. flat relief, which is the least angle that will keep the heel from dragging, yet it is too great. The 15-deg. radial relief, shown in Fig. 2, is also excessive. When a 5-deg. flat relief is used, nearly half of the flute is not cleared. A tap with a 5-deg. radial relief has the small angle which is necessary to provide ample clearance in a properly ground tap.

In time the chamfer will become too long from repeated resharpening, especially with bottoming taps. The excess may be cut off with an abrasive wheel.

Large taps can be ground on the face in the same manner as formed cutters. The work is held between centers and the tooth rest is mounted on the table with the blade against the cutting face. If this is impossible, the blade should rest against the heel of the land.

To produce threads to rigid specifications, and to insure that the die-head will operate without trouble, it is essential that thread chasers be reground correctly. A different technique is required for each type of chaser. With well-designed fixtures the chamfer and rake can be ground at almost any angle on any grinding machine that has longitudinal, transverse and vertical adjustments.

Tangent thread chasers are of three kinds. For straight threads cut without a leadscrew, the chaser acts as a lead nut to draw the stock into the die. This is controlled by the lead angle. The rake angle of tangent chasers depends upon the material to be threaded and the design of the chaser. Each manufacturer supplies a table showing recommended rake angles. Chasers for cutting tapered threads without a taper attachment are similar to those used for cutting threads with a leadscrew.

In regrinding tap and die chasers, maintain the proper angles for the chamfer, rake and clearance. Each chaser in a set must be chamfered to the same depth and angle to make sure that each will do its full share of cutting. The chamfer angle is sometimes referred to by the number of threads it covers. For instance, with National Coarse and Whitworth threads, a chamfer angle of 45 deg. will have one thread chamfered, a 33-deg. angle will chamfer 1½ threads, a 22-deg angle will chamfer two threads, and a 15-deg. angle will chamfer three threads. A long chamfer is desirable. A two-thread, 22-deg. chamfer is usually satisfactory. On some tough materials a three-thread, 15 deg. chamfer is better.

Broaches are ground on the teeth to give relief. A cup wheel is used. Top clearance usually is 30 deg. Faces of the teeth ground with a dish wheel and are undercut 6 to 10 deg. to curl chip.

Round broaches are ground cylindrically, the broach being placed between centers. The swivel is set at the proper cutting angle and the swivel head slide of the grinding machine adjusted so that the wheel is exactly over the center of the broach. The wheel head is lowered by the handwheel, and the wheel brought into contact with the tooth by moving the table.

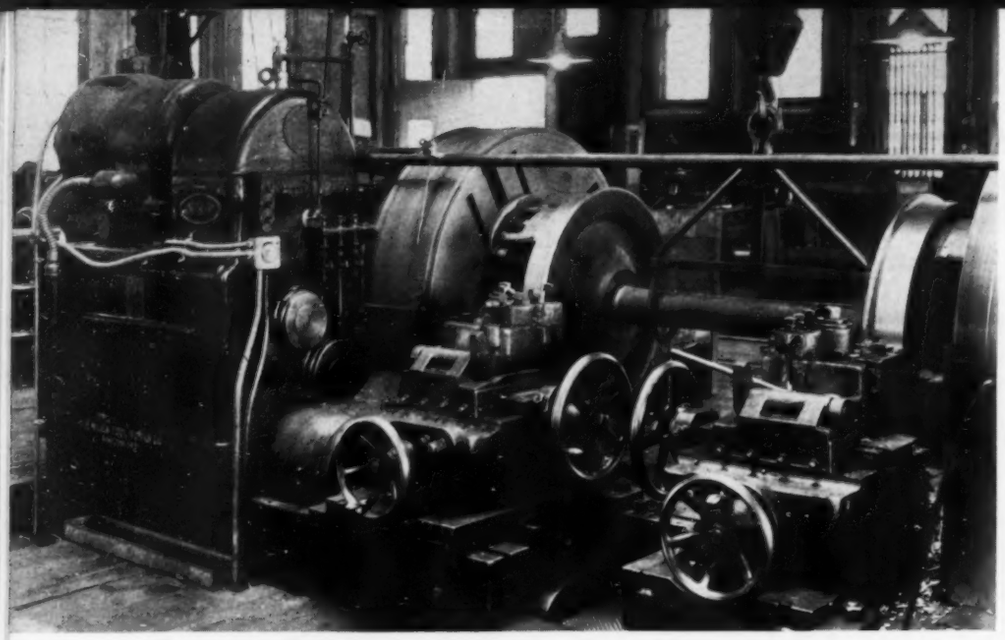
Rectangular or polygon broaches are held stationary by a dog, and the broach is indexed to the correct position by means of an index plate on the headstock. The wheel is lowered and then moved across the cutting edge of the tooth during the grinding operation.

Know Your Inspection Method

SO SENSITIVE have some of our new methods become that they must be used judiciously if they are not to do more harm than good. One aircraft manufacturer was discarding aluminum castings at an alarming rate because X-ray analysis showed a porous center. Just to make sure that all these rejects made sense, a number of them were put through all the physical tests in the calendar. The discarded castings stood the gaff equally as well as those accepted.

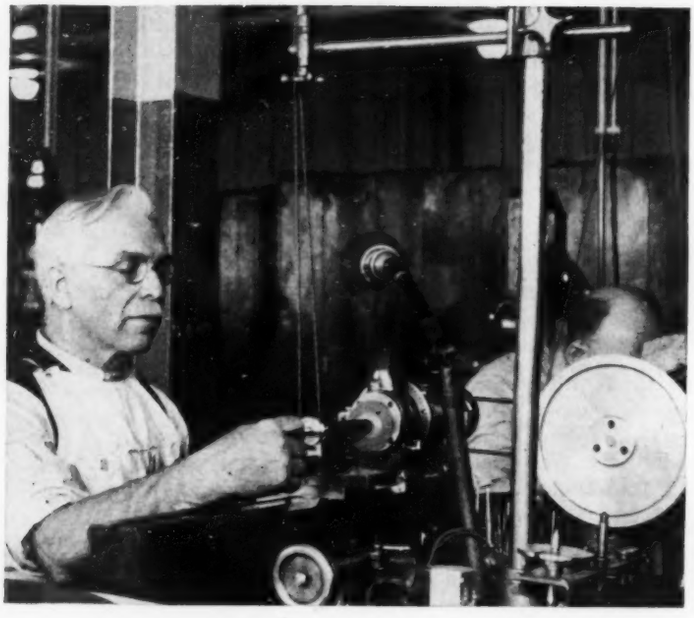
Magnaflux, too, is a super-sensitive inspection process. Under certain conditions grain boundaries of perfectly sound steel may show as flux interruptions, and be interpreted by inspectors, inexperienced in this method, as flaws. In welded parts, a change in hardness at a well-made joint may cause an irregularity in the magnetic field that may be mistaken for an imperfect weld. Dr. A. V. de Forest, president, Magnaflux Corporation, is among the first to warn against unthinking application of the process he has developed.

The answer is for inspectors to understand the methods they are employing and learn to interpret the results in terms of the use to which the parts are to be put. Otherwise properties inherent in the method of fabricating the part and which in no way affect its strength may mistakenly be made a basis for rejection. While no one wants to see defective materials get by, misinterpretations of inspection data may cause costly waste and delay in meeting schedules for the defense program.



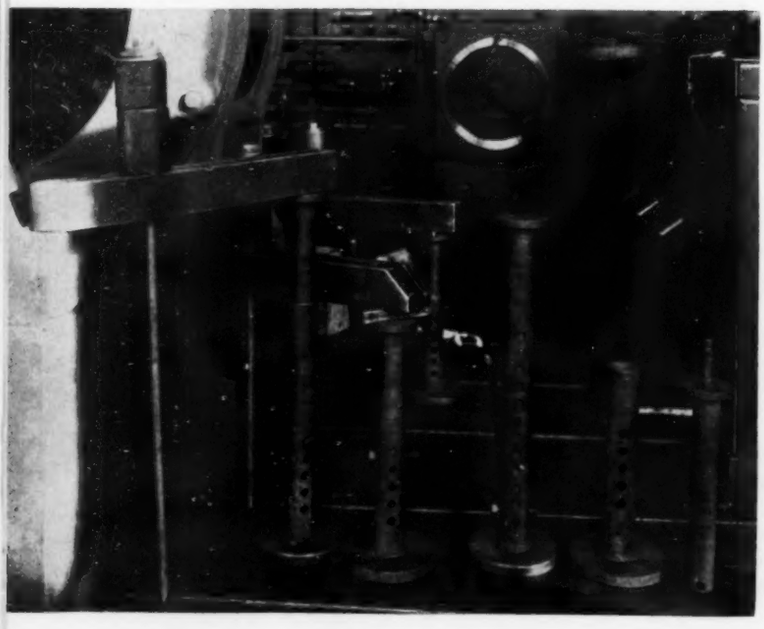
Shop

Speed range on this car-wheel lathe —originally slight because of the small variations in work diameter—had to be increased to allow for hard spots. A slower speed for a.c. operation was achieved by using a Louis Allis 30-hp. motor with an integral eddy-current clutch. Pushbutton control inserts a resistor in series with the clutch coil as long as the button is depressed. Speed reduction may be as much as 50 per cent. Milwaukee Shop; Chicago, Milwaukee and St. Paul Railroad



Better illumination is provided by reversing the cones on a bench lathe so that north light strikes the indexing head directly. Fine milling and grinding attachments are driven by round belts through overhead pulleys. Since these operations are not performed often, the drive is built for quick removal to other tools. A post supporting overhead pulleys slides into cast flanged bases permanently mounted on all benches. A foot-controlled motor is hinged to permit belt tension adjustment. Sangamo Electric Company

Safety is increased and effort reduced by use of these metal heels in place of square timbers. They are made of lengths of 2-in. pipe, welded to $\frac{3}{4}$-in. thick disks, into which telescope equal lengths of $1\frac{1}{2}$-in. pipe having $\frac{1}{2}$-in. thick disks welded on top. A $\frac{5}{8}$-in. bolt inserted through one of the holes in the larger pipe makes the heel adjustable over a wide range. J. T. Prescott, Generator Works Department, Westinghouse Electric & Manufacturing Company.



Adequate light for all lifting jobs is provided by this twin-tube fluorescent unit mounted under the crane used on the assembly floor. Boyar-Shultz Corporation

Shots

Automatic handling of heavy crankcase blocks is achieved with this set-up. When the part emerges from the washing machine at operating level it trips a limit switch which causes an air cylinder to lift the platform so the crankcase will move by gravity to the roll-over fixture. The platform makes a quarter turn to get in position. The roll-over fixture makes half a turn, putting the crankcase in position for drilling and tapping all side holes. International Harvester Company

Less burr around holes in thin sheet is produced with a drill ground to a flat spur point. This shape is also superior for drilling copper and aluminum as chip clearance is greatly improved. W. E. Eargle, time study supervisor, Generator Works Department, Westinghouse Electric & Manufacturing Company

Increased production is achieved by a foot collet release on this Hardinge machine used for turning small electric motor armatures. The handle is moved by a cable attached to the pedal, leaving hands free to insert work and manipulate tools. A coil spring is powerful enough to close the collet tightly. The pedal is used only to open collet. Installed by George Tree for the Dumore Company

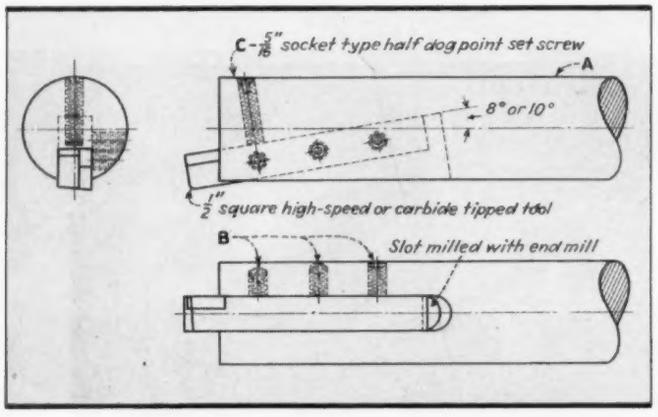
Tool steels of some 30 different types are carried by a tool and die shop. They are stored with the long pieces packed on the sides of an A-shaped rack, while shorter lengths are placed on the cross frames. Bars are identified along their full length by distinctive coloring: red for oil-hardening tool steel, white for water-hardening tool steel, yellow for high-speed steel, and aluminum for air-hardening tool steel. Other paints, superimposed on the basic colors, indicate brands. Boyar-Shultz Corporation.

IDEAS FROM PRACTICAL MEN

Rigid Boring Bar for Turret Lathes

BY THOMAS DAVIES

The illustrated boring bar was designed for use on turret lathes. It consists of a 1½-in. bar *A* of SAE 1045 steel and slotted with an end mill as shown to take the boring tool. Three hollow-head safety setscrews *B*



This toolholder, designed for turret lathes, can be used for turning or boring, making it unnecessary to use both right- and left-hand tool bits

clamp the tool in place, and one hollow-head setscrew *C* is used to adjust the front end of the tool for bar clearance in entering the hole in the work. The slot in the bar is milled at an angle of 8 or 10 deg., depending upon the cutting angle desired.

The same tool bit can be usesd for either turning or boring, making it unnecessary to use right- and left-hand tool bits. The bar is sufficiently rugged to support carbide tipped tools used at high cutting speeds.

Proper Quenching Eliminates Die Troubles

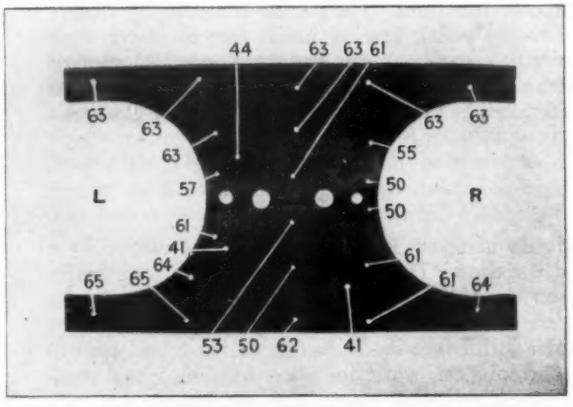
BY W. HUGHES WHITE

The die part shown in the illustration was one of several made of standard shallow-hardening straight carbon tool steel with the following analysis: 1.15 per cent carbon, 0.22 manganese, 0.010 phosphorous, 0.015 sulphur and 0.11 silicon. The overall size of the piece is 1 1/32 x 3 x 5⅛ in. It distorted excessively during hardening; concavity at the center line was 0.025 in., while the arms moved 0.015 in. toward the center.

In order to determine surface hardness, the side of the piece was etched in cold ten per cent nitric acid solution. The appearance of the etched surface is shown in the illustration, the darker portions being the fully hardened sections, while the soft spots or improperly hardened portions are plainly indicated by the lighter sections as well as by the Rockwell C readings indicated.

Inspection of the cross section, made after intentionally fracturing the piece as shown, revealed a fracture grain size by the Shepherd standards of 9¾ on the fully hardened surface and 6 on both the core and the surface where the soft spots occurred. The standard expected penetration of the fully hardened zone on this grade of steel is 5/64 to 6/64 in. In this particular piece, the deepest penetration of the hardened zone was 6/64 in., but this did not occur throughout the section. This was observed by etching the fractured cross section with cold nitric acid solution, after which the fully hardened sections were very dark, while those not hardened were very light in color.

The facts indicated plainly improper quenching of this particular part as compared to others of the same material and design. It was found that the piece had



Uneven surface hardness in this die part resulted from improper hardening technique. Proper holding and immersion in the quenching bath eliminated the soft spots and minimized distortion

been quenched by holding it about the center with heavy tongs and immersing it horizontally in the bath.

A uniform surface hardness of 63 to 65 Rockwell C was obtained on the next piece made by immersing it vertically in a ten per cent brine solution, holding it with light tongs which grasped wires passed through the holes. It was agitated continuously in the bath until it could be handled comfortably in the bare hands. It was hardened at 1,450 F and drawn at 300 F.

Flat pieces such as the one shown will distort considerably if dropped flat into the quenching bath. Always immerse them end first, with the least area in contact with the holding wires or tongs.

Bending Device Forms S-Hooks Easily

BY W.ª E. ABBOTT

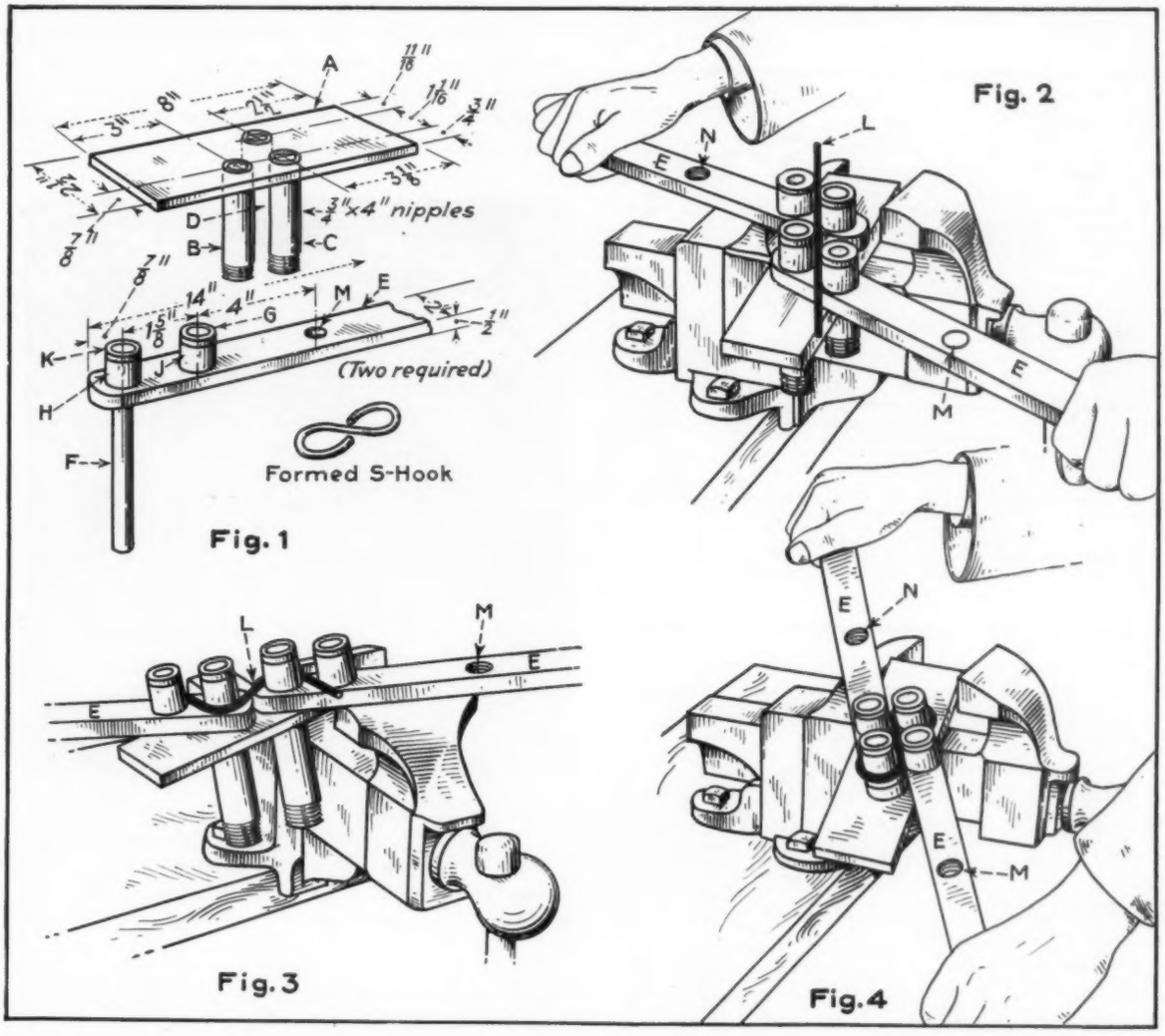
The fabrication of S-hooks from $\frac{1}{4}$-in. and $\frac{3}{8}$-in. cold stock, as well as from heated $\frac{1}{2}$-in. round and $\frac{1}{4}$x$\frac{3}{4}$-in. flat stock can be accomplished with remarkable ease by the illustrated device. As shown in Fig. 1, it consists of a piece of $\frac{1}{2}$x2$\frac{1}{2}$x8-in. flat stock *A* drilled as shown and tapped from the under-side to take three $\frac{3}{4}$-in. nipples *B, C* and *D* which are 4 in. long. The handles *E* of $\frac{1}{2}$x2-in. stock are 14 in. long, and are threaded to take pins *F* and *G*. Pin *G* which extends through the handle, is made from a short $\frac{3}{4}$-in. round-head bolt, and is fitted with sleeve or roller *J*. Pin *F* is made from $\frac{3}{4}$-in. round iron, threaded to screw in the handle *E* and is capped with the thin, round nut *K*. Before *K* is screwed and riveted in place, roller *H* is applied. Pin *F* extends $3\frac{1}{2}$ in. below *E*.

When assembled, the pin *F* of one handle fits into nipple *B*. The pin on the other handle fits into nipple *C* for bending hooks from $8\frac{1}{2}$-in. stock, or into nipple *D* for bending stock $10\frac{1}{2}$ in. long. The first, middle and final positions of the handle when bending an S-hook are shown in Figs. 2, 3 and 4. The stock *L* is centered as shown and the handles *E* are rotated clockwise.

This device can also be used for making J-hooks. In this case, the handles *E* are set at right angles to each other. Stock to be bent is placed alongside the pins *F* and *G* of one handle which is to be held stationary, while the end of the stock to be bent is placed between the pins on the other handle. If a link is to be made, the *J* is made on one end of the stock, and the stock is then reversed so that the oval can be completed.

A link made from $\frac{1}{8}$x1-in. flat iron can be used as a flat surface when placed over pins *F* and *G* of the stationary handle. Sleeves can be made to slip over one or more of the pins to change the size of opening in the S-hooks, or to take up space between the pins when bending small stock.

In some cases it may be desirable to have the



S-Hooks and oval chain links can be made in this device by placing round or flat stock between the rollers and rotating the handles clockwise. Hooks of various diameters can be made by changing the location of one of the handles

handles *E* move uniformly when bending a hook. This can be accomplished by an additional handle made from ½x1¼-in. stock near the end of which is drilled and tapped a hole for a ¾x2½-in. pipe nipple. The ¾x2½-in. studs are screwed into handles *E* at holes *M* and *N*. The nipple at the end of the ½x1¼-in. handle is placed over the stud in hole *M*, and the hand is swung clockwise until it bears against the stud in hole *N*. Rotation of handles *E* in a clockwise direction and at uniform rate is accomplished by further clockwise motion of the ½x1¼-in. handle.

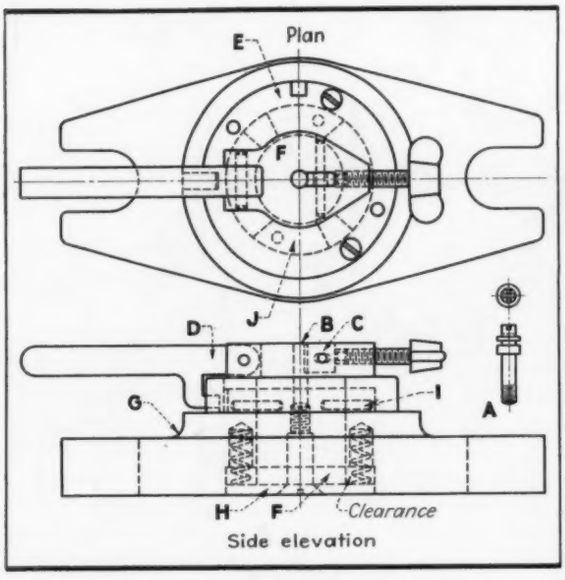
This bending device was built for making S-hooks used to hang locomotive-cab curtains.

Fixture Mills Slots of Unequal Depths

BY PETER L. BUDWITZ

We had to mill two slots of unequal depths at 90 deg. apart in the head of screw *A*. The indexing fixture shown in the drawing was designed for the operation.

The screw is set in hole *B* and fastened with clamp



The height of the work in this indexing fixture is set by cam action so that slots 90 deg. apart can be milled to unequal depths

C operated by a thumb screw. Index lever *D* is pivoted to part *F* with a pin. Indexing is accomplished by raising the lever *D* which engages a slot in the index plate *E*, and turning the work nest so that the engaging tongue of the lever enters the slot located at 90 deg. in the index plate.

As part *F* is rotated it also raises the work so that the second slot to be milled will be deeper than the one cut previously. Part *F* is retained in base *G* of the fixture by two hardened pins *I* inserted in the periphery of part *F*.

Pins *I* engage two cam segments *J* which are fastened to base *G* inside of the index plate. Two holes are drilled into the base to receive springs. These springs exert pressure against the retaining washer, thus forcing the pins in part *F* to follow the rise of the cam segments as the work is being indexed. Clearance between the retaining washer and the large hole in the base should be noted. This clearance permits up-and-down movement of the work. The index plate is fastened to the base of the fixture with screws and dowel pins.

Carrier for Boiler Checks Reseating Tools

BY A. H. CARROLL

Usually locomotive boiler checks are situated on the discharge pipe near the front end of the boiler. When a mechanic overhauls the checks, he must climb from the floor to the running board several times to procure the proper sizes of reamers and valve reseating tools. In order to avoid needless climbing, an engine house employee built the carrier *A* for these reseating tools.

The frame of the carrier is made from $\frac{3}{16}$-in. plate, is about 4 in. wide to accommodate the reseating tools, which are dropped through holes drilled for that purpose. The legs of the carrier are long enough to keep the ends of the tools off the floor, bench or running board. The short reamer on the right has a plate

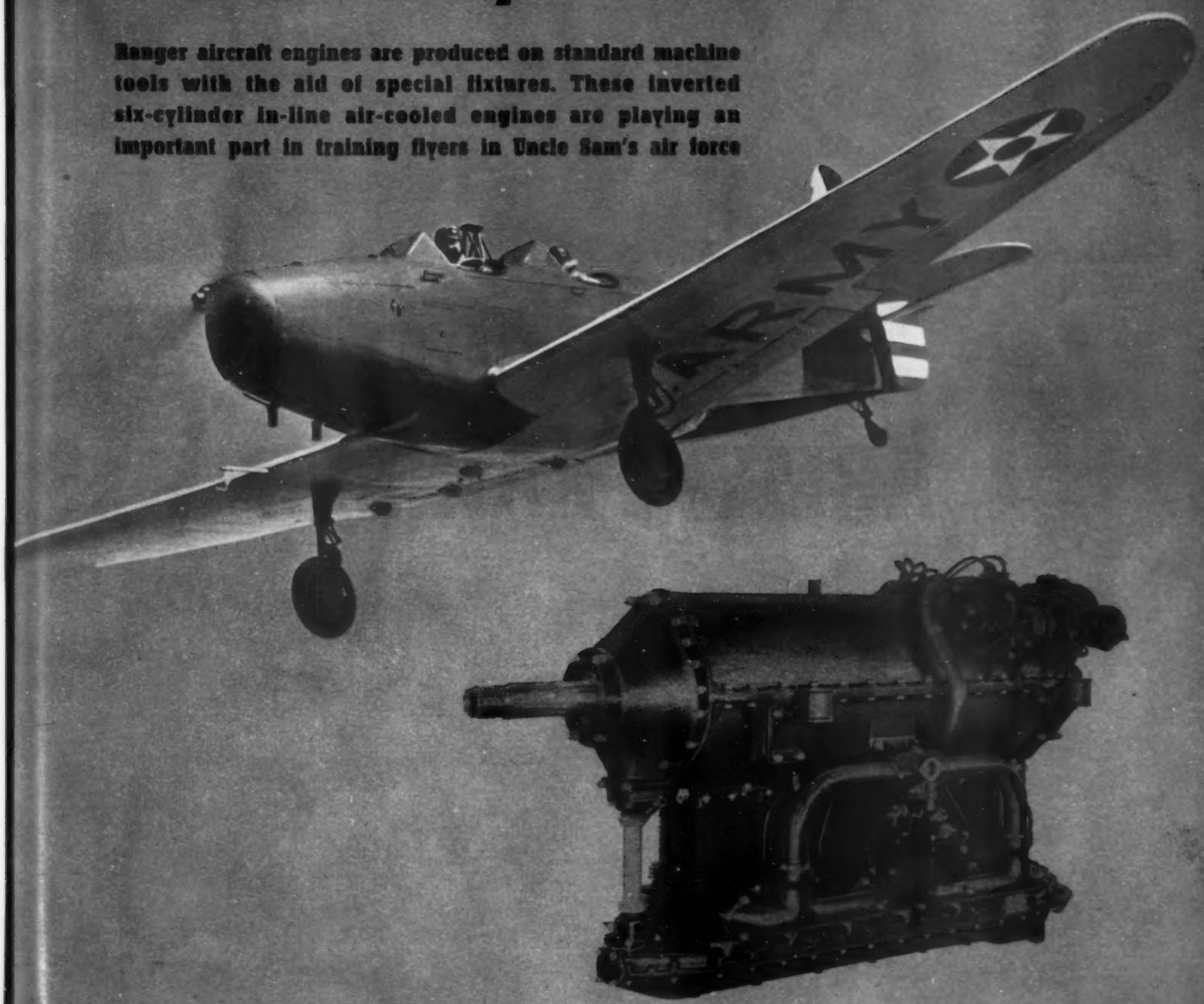
When a mechanic repairs a locomotive boiler check, he may need as many as three reseating tools. These can be carried conveniently to the running board in a rack made from 3/16x4-in. plate with holes cut therein to receive the tools

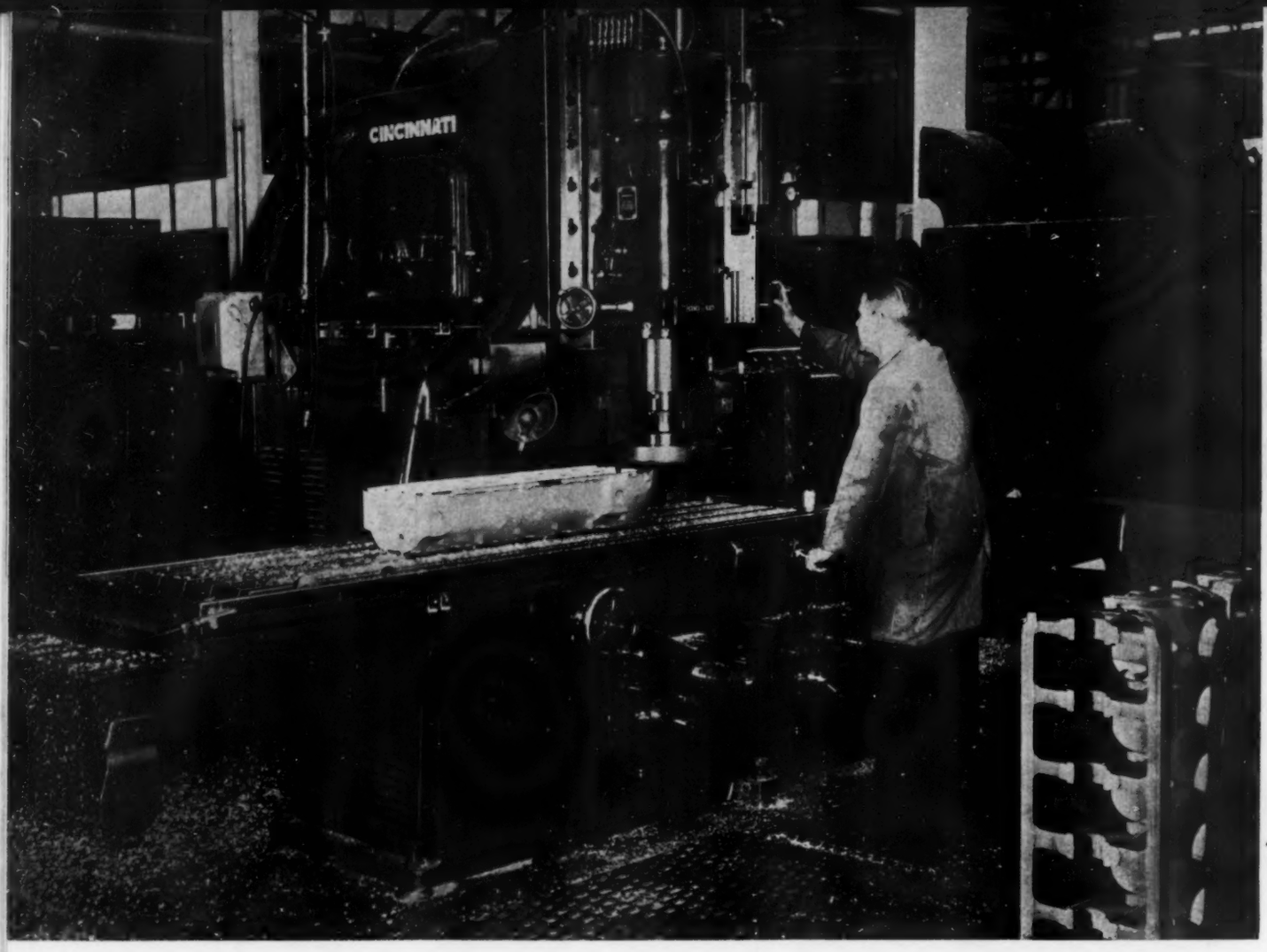
welded to the end of the rack to prevent the reamer from falling through, since the body and cap of the reamer are of the same size. The handle is a piece of ¼-in. welding rod, bent to shape and welded to the frame.

SECTION OF AMERICAN MACHINIST

Power for Army Trainers

Ranger aircraft engines are produced on standard machine tools with the aid of special fixtures. These inverted six-cylinder in-line air-cooled engines are playing an important part in training flyers in Uncle Sam's air force





POWER FOR ARMY TRAINERS

RANGER AIRCRAFT ENGINES, Division of Fairchild Engine and Airplane Corporation, is building a six-cylinder in-line direct-drive engine for training planes used by the Army Air Corps. The engine is inverted and air-cooled, but is not supercharged.

The main crankcases of these engines are of heat-treated cast-aluminum alloy. The upper and lower sections are parted at the crankshaft center line. Both sections are ribbed with seven main bronzed-backed babbitt-lined bearings, and are clamped together by long studs anchored in the upper webs and extending entirely through the lower webs and crankcases.

The front crankcase section carries the propeller thrust bearing and gears for driving the accessory drive shaft and the camshaft vertical drive shaft. The rear crankcase section carries the drive gears for the accessories.

All parts of the crankcase are zinc chromated and baked 1 hr. at 300 F., as a ground coat for painting.

Prior to machining, the lower half of the crankcase is scribed horizontally at the flange and cylinder pads and it is milled to these lines. The lower crankcase is placed on the table of the Cincinnati Hydro-Tel shown in Fig. 1, and leveled with an indicator for rough milling the cylinder-pad face. A 10-in. fly cutter, with carbide tools is used. The roughing cut, leaving $\frac{1}{32}$ in. for finishing, is made at a feed of 10 in. per min.

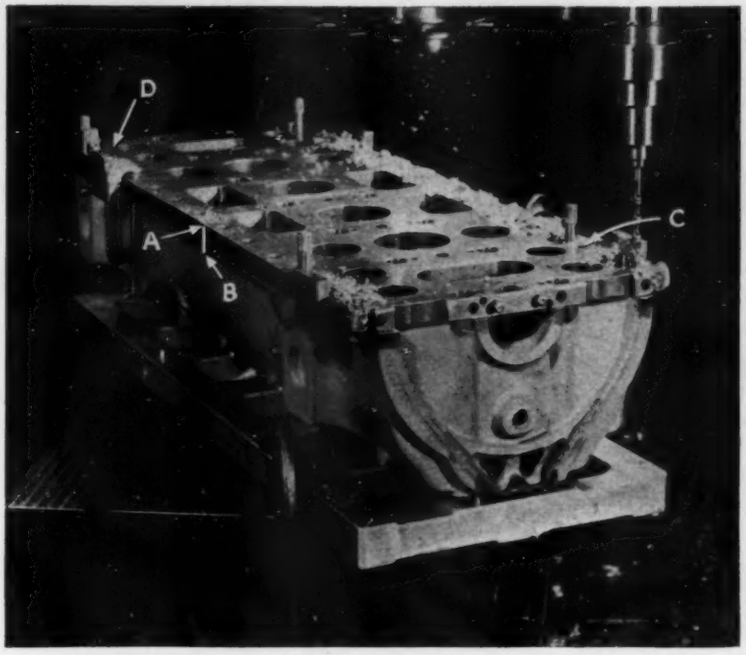


Fig. 2—Holes in the crankcase flanges are jig drilled. The jig is located by lines scribed on the casting and is held by plugs and adjustable clamps

Fig. 1—Crankcase flange and cylinder faces of the aluminum castings are machined with a 10-in. fly cutter at a feed of 10 in. per minute

After rough cutting the cylinder pad face, the crankcase is inverted for machining the flange fit. It is clamped on the table and rough milled to an overall height of $6\frac{11}{16}$ in., allowing 0.020 in. for finishing on both sides. The finishing cut on the flange fit is then made to $6\frac{23}{32}$ in. ± 0.010 in. overall height between the cylinder pad face and the flange fit. The crankcase is then inverted again for finishing the cylinder pad face. This is finish milled to a height between the flange fit and the cylinder pad face of 6.625 in. ± 0.004 in.

The lower crankcase is then set on the bed of a drill press, and the drill jig shown in Fig. 2 is placed on the flange face. The jig is located by a center line *A* on the jig, which matches the center line *B* scribed previously on the crankcase. Two dowel holes *C* and *D* $\frac{15}{64}$ in. diameter and $\frac{13}{32}$ in. deep are drilled at diagonal corners of the crankcase. These holes are then reamed 0.250 ± 0.0005 in. diameter and $\frac{3}{8}$ in. deep. In succeeding machining operations, dowels in holding fixtures fit into the dowel holes, and locate the crankcase accurately and quickly.

With the drill jig on the flange face of the lower crankcase, 26 holes $\frac{11}{32}$ in. diameter are drilled for flange bolts.

The lower crankcase is then placed on the jig

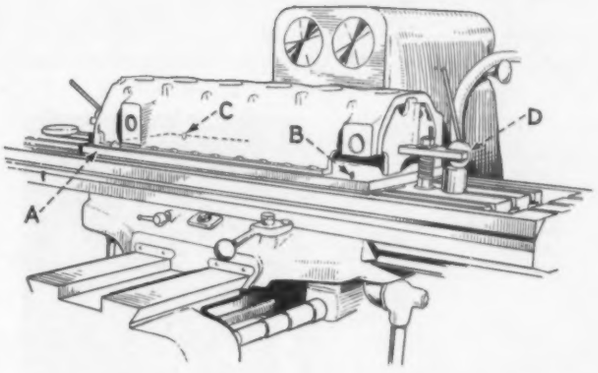


Fig. 3—When milling the flange bosses, the casting is positioned by accurately located dowel pins, the diameters of which are 0.205 ± 0.0005 in.

shown in Fig. 3, which consists of a flat base *A* bolted on the table of a Van Norman or Milwaukee milling machine and having two dowels *B* and *C* correspond to the dowel holes *C* and *D* shown in Fig. 2. The crankcase is placed over these dowels, thus locating it accurately on the milling machine table, and it is secured by eccentric clamps *D*. Then all flange-hole bosses on one side of the case are milled to the required thickness, excepting those adjacent to shoulders; the latter, in close quarters, are later spot-faced with a back-facing cutter. The case is reversed and seven bosses on the opposite flange are then milled. All face surfaces for flange bolts are held $\frac{15}{32}$ in. uniform height on each crankcase for gaging

purposes when drilling bearing cap stud holes in later operations.

The crankcase is then placed on the jig in Fig. 4 where 48 cylinder holes, eight at a time, are drilled. It is located on the fixture by dowel pins *A* and *B*. The table *C* sliding on the base of the fixture is located for drilling each set of holes by indexing pin *D* and indexing holes *E*. The case is a sliding fit under the overarm *F* and requires no other holddown means during the drilling of the cylinder pad holes.

The crankcase is then loaded in a fixture similar to the one shown in Fig. 3, and the engine mounting pads are milled. The cutter is set 0.125 in. from the outside diameter of the locating dowel on the fixture. Two mounting pads are milled on one side to 5.8125 ± 0.005 in. from the center of the case. The case is then reversed in the fixture and the opposite pads are milled to the same dimensions.

The same type of fixture used for milling the flange bolt bosses and the engine mounting pads is used for rough boring, finished boring, and chamfering the six cylinder holes. As shown in Fig. 5, the crankcase is loaded in this fixture attached to an indexing plate, with an indexing pin and holes to locate the bore precisely beneath the cutter. The cylinder holes are finish bored to 4.318 ± 0.002 in. diameter. At the same time the holes are chamfered to 60 deg. and 4.526 + 0.010 — 0.000 in. diameter.

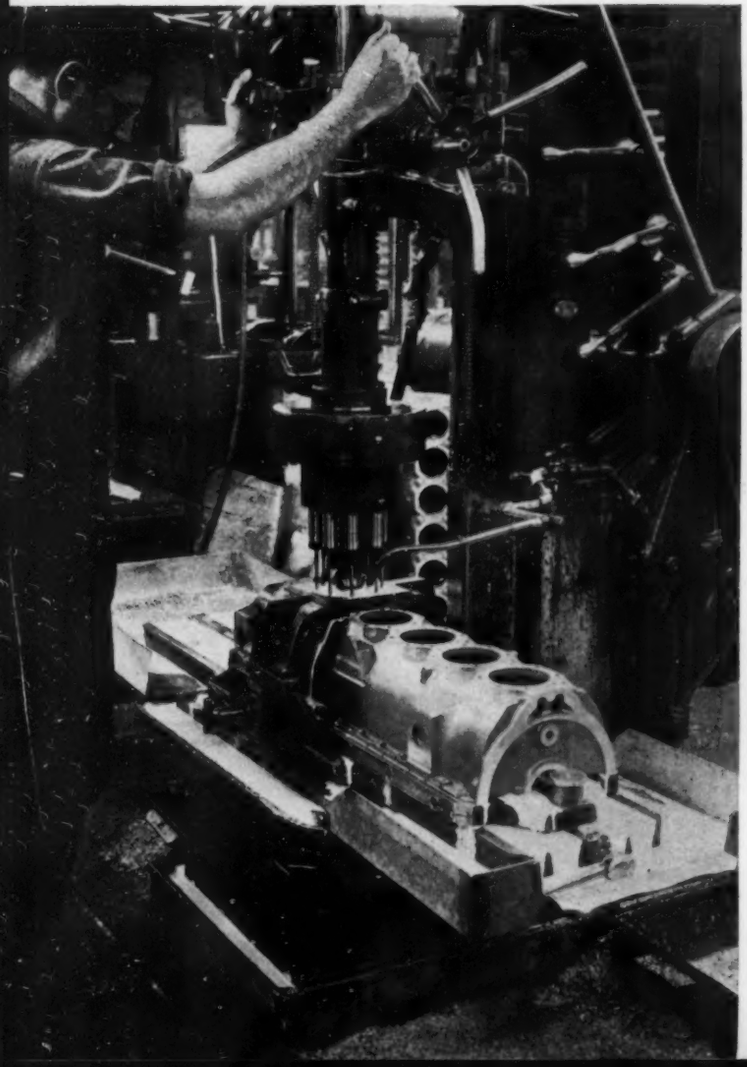
In succeeding operations, the carburetor bracket pad and the ends of the lower crankcase are milled to size. The locating fixture used in these operations is the same as shown in Fig. 3.

After the 48 cylinder pad holes are countersunk and tapped on the Bakewell tapping machine shown in Fig. 6, fourteen main bearing stud holes are drilled, counterbored and reamed. This operation is illustrated in Fig. 8, showing the same operation on the top half of the crankcase. These holes are drilled through the lower half of the crankcase but are reamed to 0.594 ± 0.0005 in. diameter by $1\frac{3}{16}$ in. deep from the flange face. After the holes are drilled and reamed, the jig is removed, and the holes countersunk by hand to remove burrs.

In succeeding operations, the main bearing stud holes *A*, shown in Fig. 7, are spot-faced; also the flange bosses *B*, adjacent to mounting pads and ends of the crankcase, are spot-faced. Holes *C* are then drilled in the mounting pads, which are also counterbored at *D*. Other holes, such as those for carburetor brackets, ignition clips, and dowel holes are drilled, countersunk and tapped.

The lower half of the crankcase is then mounted in the fixture shown in Fig. 7 on a Giddings & Lewis horizontal boring mill for milling the main bearing cap webs to the required width.

The boring bar has seven cutting heads, with three cutters on each side of the middle five heads, and three cutters on the inside of the outside two heads. Crossheads *E* slide back and forth in the back half *F* of the fixture as the table is traversed to hold the bar rigid during the cutting operation. Two dowels locate the lower half of the crankcase on the back half



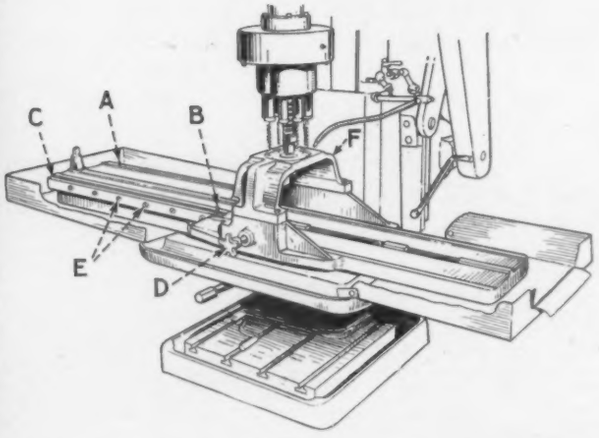


Fig. 4—This indexing fixture is used to drill 48 holes, eight a time, in the cylinder pads. As in Fig. 3, the casting is located by dowels

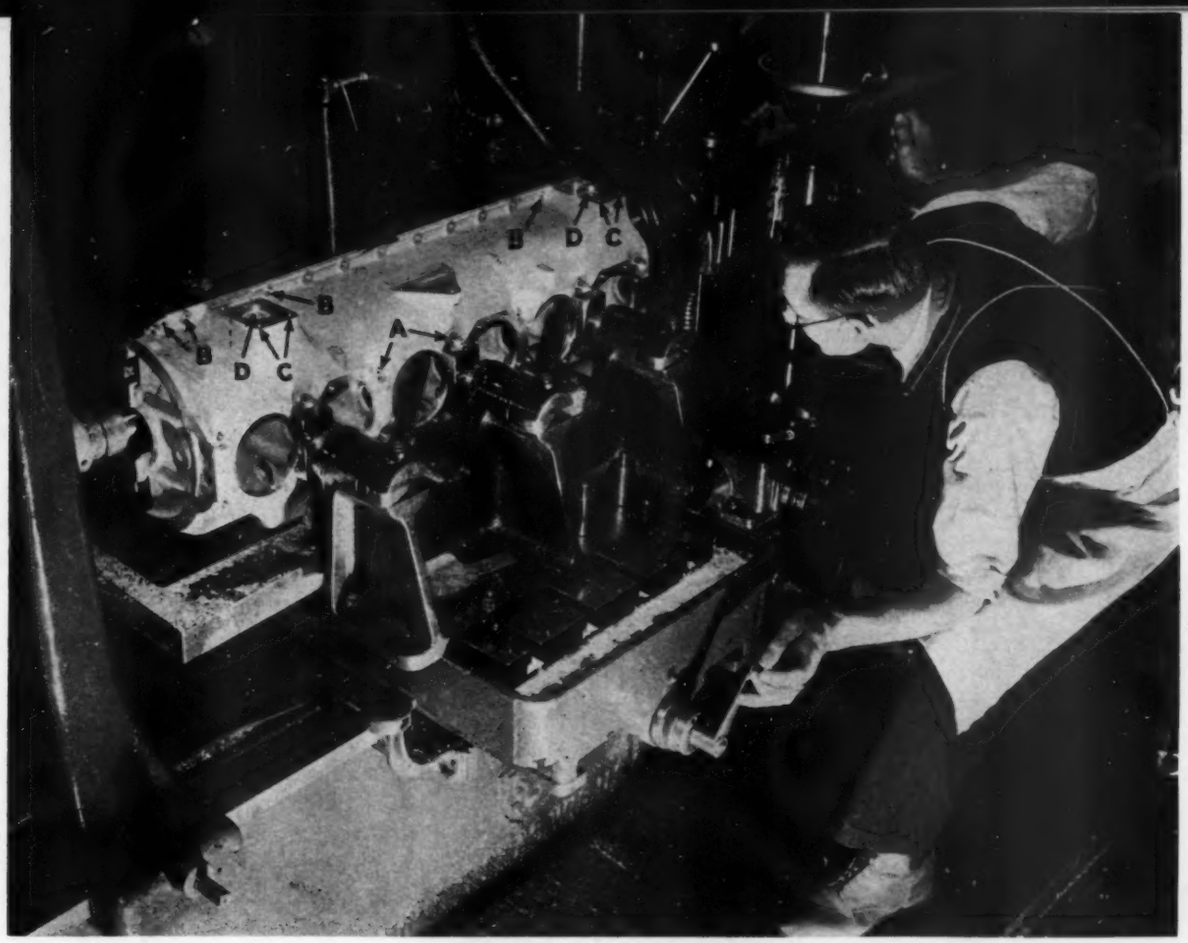


Fig. 7—The bearing caps in both the upper and lower halves of the crankcase are machined to width in this horizontal boring mill. The boring bar has seven tool holders, with three bits on each face. The bar is held rigid by cross heads which slide in the fixture as the table traverses

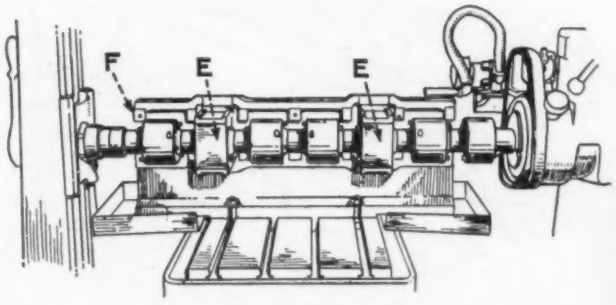
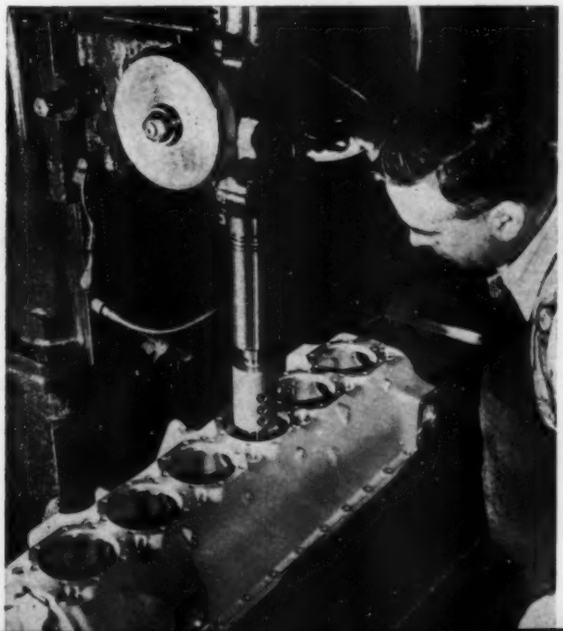


Fig. 5—Each cylinder hole is roughed, finished and chamfered in succession as the spindle feeds down. The fixture is indexed to position each hole for this operation



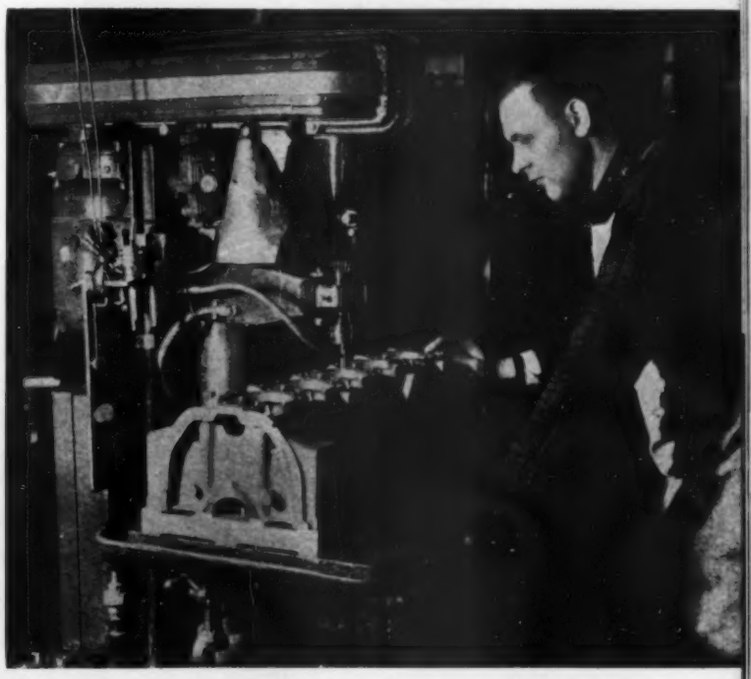


Fig. 6—Each cylinder pad hole is tapped individually to insure accuracy. Here again, the casting is positioned by dowels in the base plate

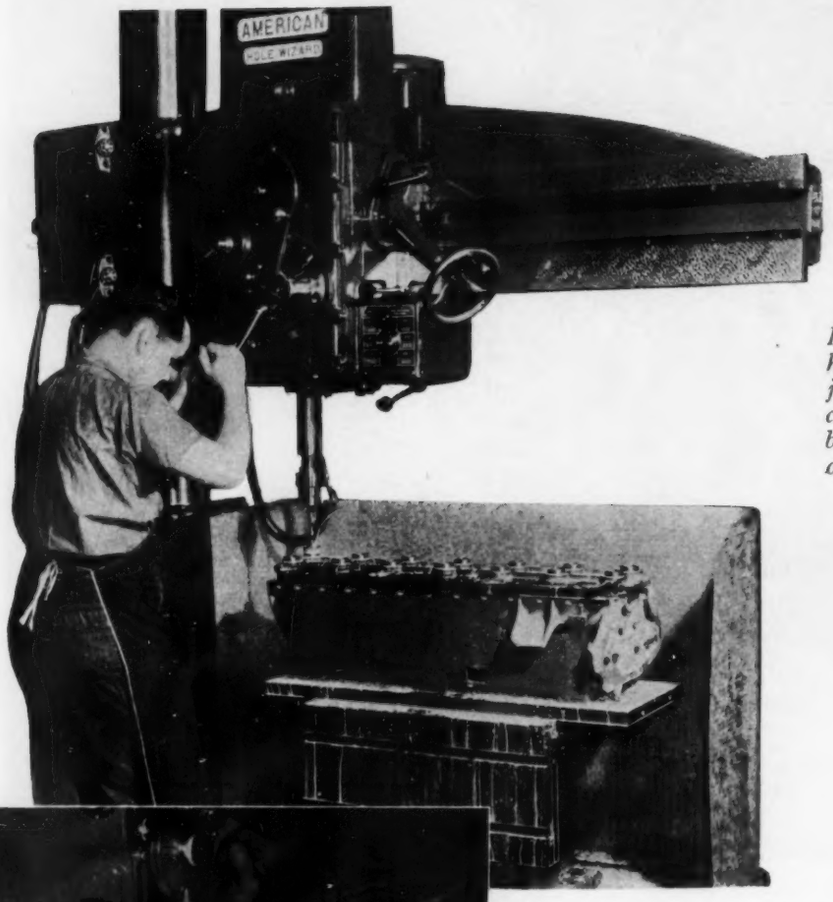


Fig. 8—Main bearing stud holes are drilled with this jig. The casting rests in a cradle on the flange-bolt bosses, which were previously milled to precise thickness

Fig. 9—Relief in the main bearing stud holes, reamed to 0.594 in. diameter and $\frac{11}{16}$ in. deep, makes possible the use of precision plugs when locating this jig for tapping the holes

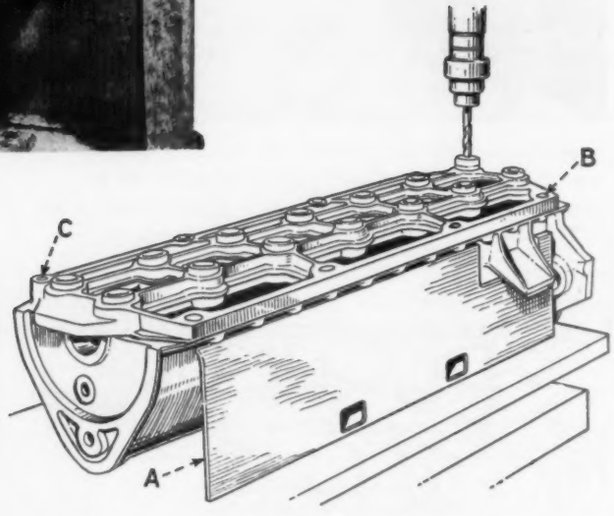
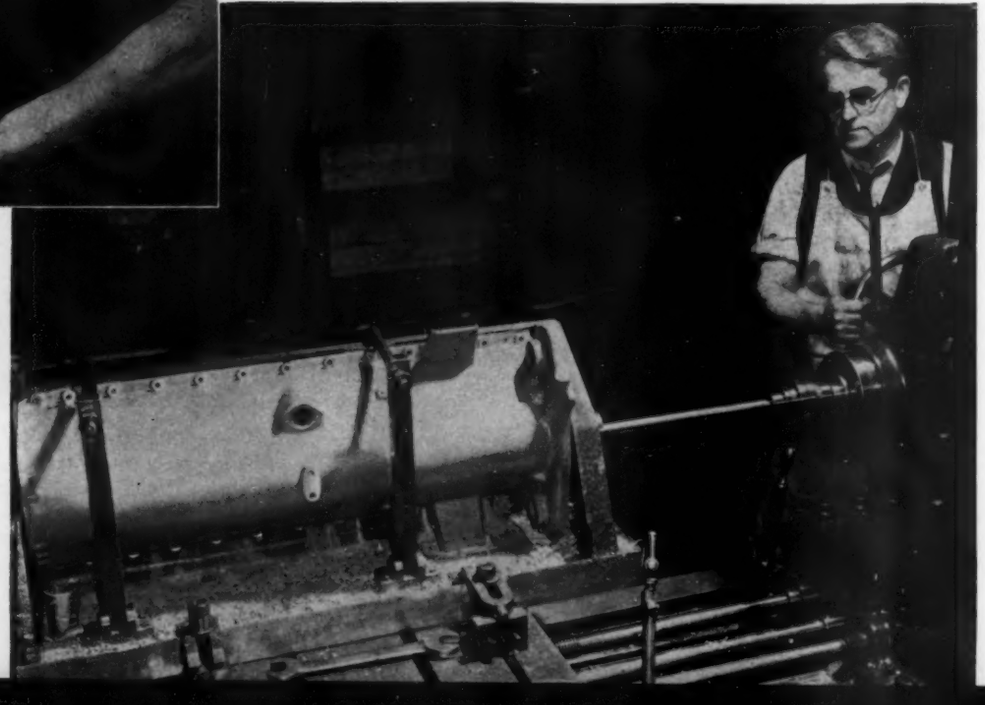


Fig. 10—The accessory drive shaft runs through the upper half of the crankcase; seven bearings are bored with this piloted boring bar



F of this fixture. The front half of the fixture, shown in the photograph, clamps the crankcase in position. As machining begins, the table is traversed forward against the cutters, while the crossheads *E* slide forward out of the back half *F* of the fixture.

The final machining operations on the lower half of the crankcase include straddle milling two oil-seal grooves along the length of the flange faces. After tapping 16 mounting pad holes, two carburetor holes, and six dowel holes, the crankcase is cleaned and inspected.

After applying a coat of zinc chromate primer, and baking for 1 hr. at 300 F., horizontal and vertical layout lines are scribed on both sides of the upper crankcase flange. The flange face is then milled on the Cincinnati Hydro-Tel shown in Fig. 1.

A drill jig, similar to the one shown in Fig. 2, is used for drilling 26 flange and dowel holes.

The procedure for milling the flange bosses on the upper half of the crankcase is the same as on the lower half, using a fixture similar to the one shown in Fig. 3. Two eyebolt bosses and one for a breather pipe are milled in the same operation.

The fixture shown in Fig. 8 is used for drilling, reaming and counterboring main bearing stud holes. The crankcase flange bosses are set on a cradle *A*, the flange bosses having been previously machined square and to precise thickness. The drill jig is located by dowels at points *B* and *C* prior to bolting down with clamps or studs through the flange holes. The holes are then drilled $\frac{15}{32}$ in. diameter and $2\frac{1}{8}$ in. deep, and reamed 0.594 in. diameter and $\frac{1}{16}$ in. deep for stud body fit.

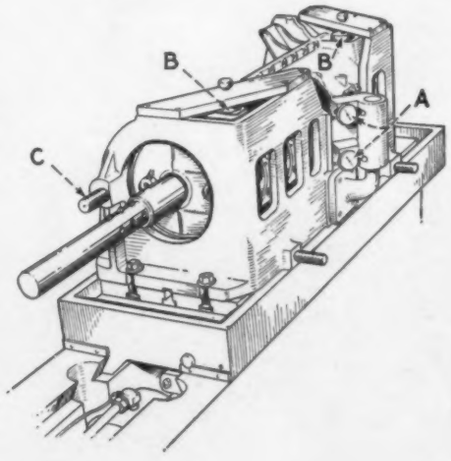


Fig. 11—When the crankcase is assembled, the main bearings are bored and the flange fit for the crankcase front is faced and chamfered. The work is lined up in the jig by indicators and by precision plugs in the accessory driveshaft holes

In succeeding operations breather pad holes, lifting eye-bolt holes, and ignition clip holes are drilled, countersunk and tapped; also, air release holes are drilled into the stud holes.

In Fig. 9 is shown the fixture used for tapping the main bearing stud holes. In this fixture, the upper crankcase is mounted on four studs *A*. The fixture is located by plugs *B* which are 0.594 in. in diameter, the reamed size of the stud holes. This reamed size is $\frac{11}{16}$ in. deep. Consequently, these plugs can be inserted in any of the holes prior to or after tapping.

The ends of the upper crankcase are then milled in a fixture similar to the one shown in Fig. 3.

The fixture shown in Fig. 7 is used for straddle milling the main bearing caps to required width.

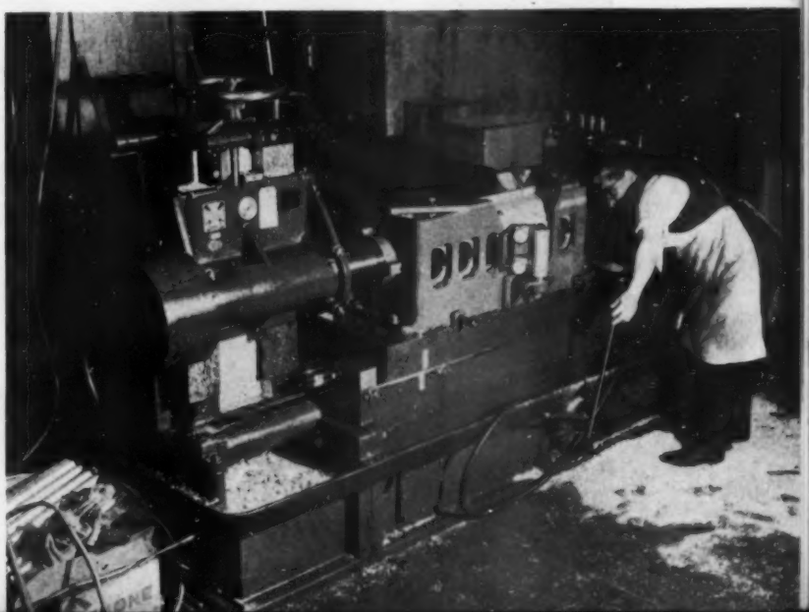
The accessory driveshaft bearings in the upper half of the crankcase are drilled and reamed as shown in Fig. 10. This is done either in a Lucas or Fitchburg horizontal boring mill.

The accessory drives for the engine are protected from crankshaft torsional vibration and shock loading by the long hollow flexible shaft located in the top of the crankcase. This shaft transmits the drive from the propeller end of the engine to the accessory drives in the rear section and completely isolates them from any detrimental vibrations. The accessory drive shaft is carried in 7 bearings in the crankcase webs and acts as a header for distribution of oil to the main bearings and the front end of the engine.

Drives are provided for all accessories, and mounting pads or connections for these are located at convenient points on the rear of the engine. They consist of the starter, generator, fuel pump, vacuum pump, tachometers, and scavenge and pressure oil pumps.

After drilling and tapping all miscellaneous holes for these various parts on the outside of the upper crankcase, the casting is cleaned and inspected, and is assembled to the lower half of the case for further machining operation.

The first operation on the assembled crankcase is



boring the main bearing. This is done in the fixture shown in Fig. 11. The assembled case is on its side in the fixture and located by the two lower mounting pads. It is then aligned by the two indicators *A*. When the cylinder pad face is parallel in the fixture the two clamps *B* are set against the top mounting pads. Two plugs *C* fit into the accessory drive shaft holes. This clamps the case rigidly in position for boring the main bearings; also, the end of the crankcase is bored to fit the crankcase front. The boring bar is inserted through the assembly shown in the photograph, and the crankcase front fit bored first; then, as the table traverses, pulling the boring tools through the assembly, the bearing fit is machined.

After the main bearings are bored, two arbors are inserted, and the case is ready for facing the ends as shown in Fig. 12. The assembled case is mounted between centers on the American Pacemaker and both ends faced simultaneously.

Gear shaft holes, accessory drive shaft holes, and cover stud holes are drilled, reamed and counterbored in succeeding operations as shown in Fig. 13.

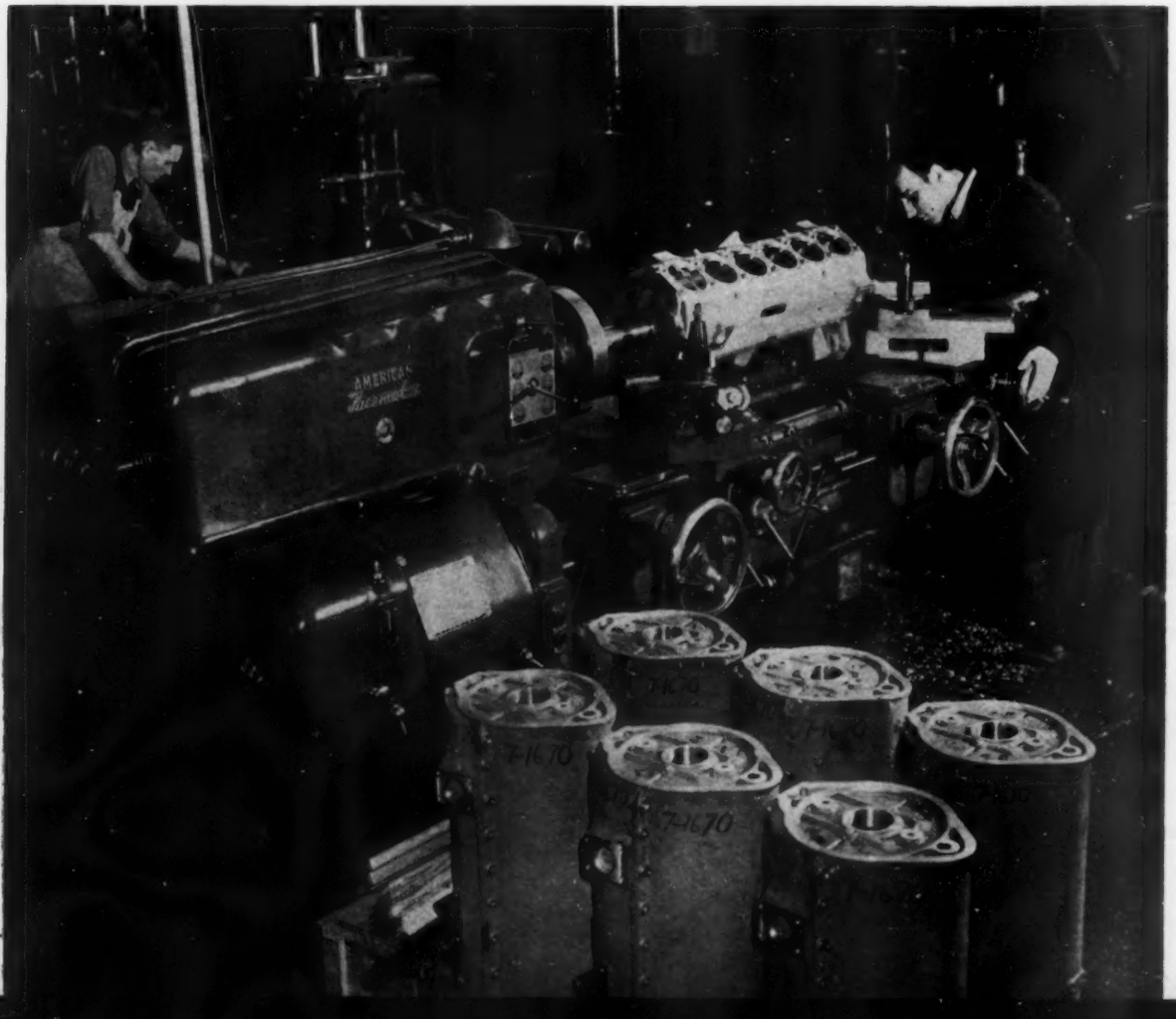
The crankcase is disassembled and then the magneto pads on the upper half are milled using the fixture shown in Fig. 14. The upper half is located in this fixture by plugs *A* which fit into the magneto drive shaft holes, and by the main bearing holes at each end. The case is clamped rigidly in place by screws *B*, three of which are on each end of the fixture.

Oil holes are drilled through the main bearings to the accessory drive shaft holes in the upper crankcase. One oil hole is drilled in the No. 1 bearing cap in the lower crankcase through to the magneto drive gear bearing. In all other bearing caps in the lower crankcase, dowel holes are drilled to hold the main bearings in place. The drill jig for the operation in the lower crankcase is shown in Fig. 15; the same jig is used for drilling the holes in the upper half of the crankcase.

In Fig. 16, the upper half of the crankcase is shown mounted in a fixture for drilling the main oil holes from the magneto shaft holes through to the main bearing at the front of the crankcase.

The crankcase front is shown in Fig. 17. The flange fit on the crankcase front for mating with the assembled crankcase is machined in a Jones & Lamson turret lathe to finished size. The front is then

Fig. 12—The flange fits for the front and rear sections of the crankcase are faced simultaneously in this lathe. The casting is chucked on arbors held in the front and rear main bearings



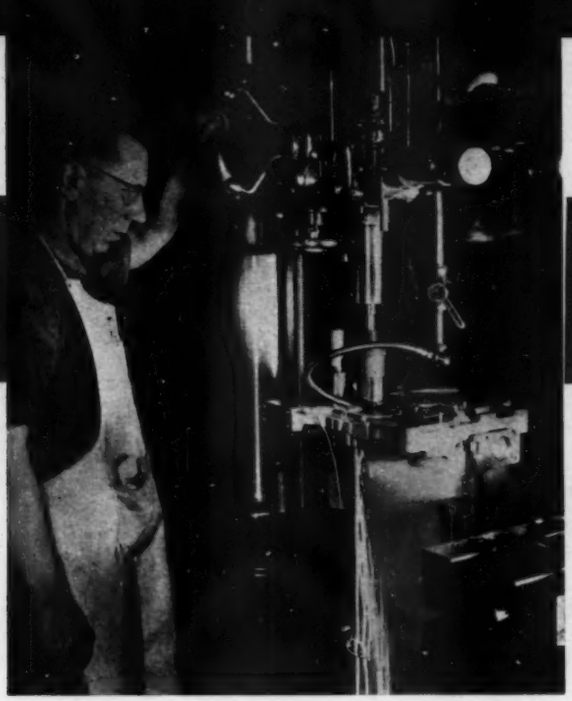


Fig. 13—All holes are jig drilled, reamed and counterbored in both ends of the assembled crankcase. The jig is positioned by plugs and the contour of the case

Fig. 14—Magneto pads are milled with fly cutters. The upper half of the crank-case is held in the fixture by plugs fitting in gear and accessory drive-shaft holes

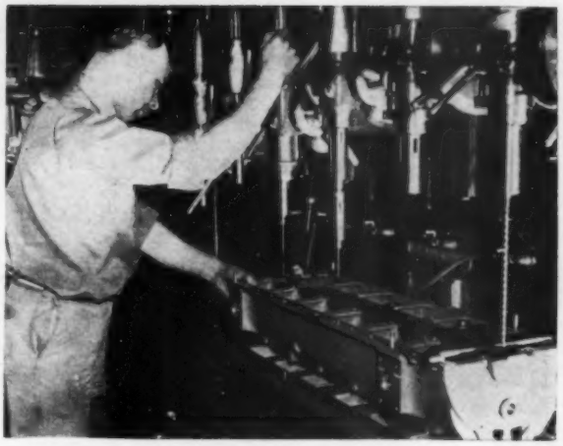


Fig. 15—This jig is used to drill and ream oil and dowel holes in the main bearing bores

mounted in the fixture shown in Fig. 17 for boring the vertical drive shaft hole. The flange bolt holes and gear shaft holes are drilled, reamed and counterbored to finished dimensions, as shown in Fig. 18. The fixture shown in Fig. 17 is used, but turned on its side.

The crankcase rear is first milled on its flange face in the Cincinnati Hydro-Tel milling machine, after taking a roughing cut on the pressure oil pump pad of the opposite face.

After facing the flange fit on the Cincinnati Hydro-Tel, the tachometer and generator pads are finished to size. This completes the milling operations on both faces of the crankcase rear.

After the flange face, generator pads and tachometer pads are milled to size, the crankcase rear is placed in the jig shown in Fig. 19, and located by the contour of the flange fit. Dowel, gear shaft, generator shaft, and flange bolt holes are then drilled and reamed. The crankcase rear is then placed on a fixture similar to the one shown in Fig. 3, and all miscellaneous holes are drilled, being located from the dowel holes.

The camshaft is a heat-treated alloy steel forging, carried in a housing which bolts directly to the cylinder heads. The camshaft housing and cover are of magnesium alloy. The camshaft is supported on eight bearings, one located at each end of the shaft and one adjacent to each of the six pairs of cams. It is driven from a vertical shaft, which takes its drive from the front end of the crankshaft. The valves are operated by rocker arms, which are provided with crowned roller cam followers and ball-type adjusting screws. The end of the adjusting screw is cut and fitted with a steel ball, the latter having a flat face which provides a large area of contacts with the valve stem. From the hollow crankshaft, pressure oil is fed directly to the camshaft bearings. Holes drilled in the camshaft between each pair of cams supply oil to the rocker arms, cam followers and adjusting screws.

The camshaft housing is milled on the flange face and cylinder pad fit on the Cincinnati Hydro-Tel as shown in Fig. 20. The housing is then placed in a fixture for drilling 32 stud holes on the flange fit and two dowel holes, the latter of which are the locating holes for future operations as explained in conjunction with Fig. 3.

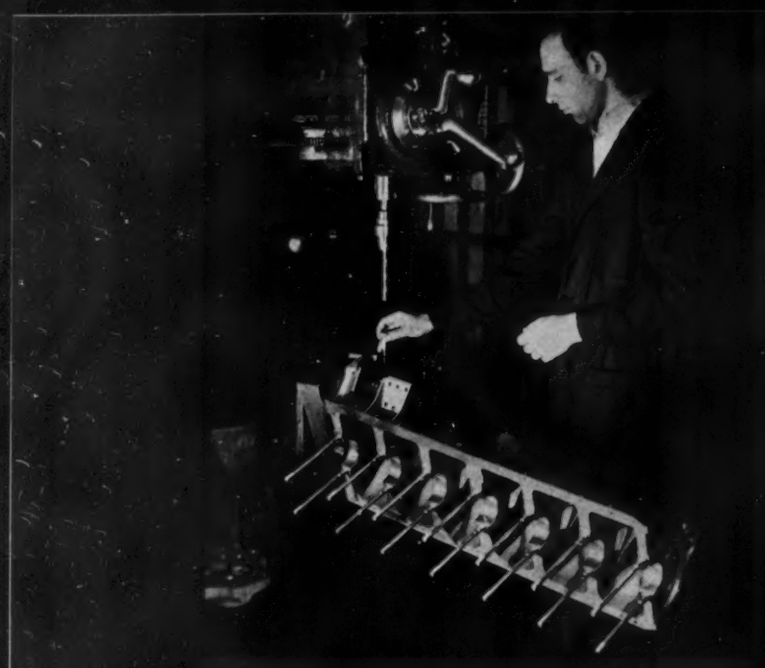


Fig. 16—Oil holes running from the magneto shaft to the main bearings are drilled in this radial

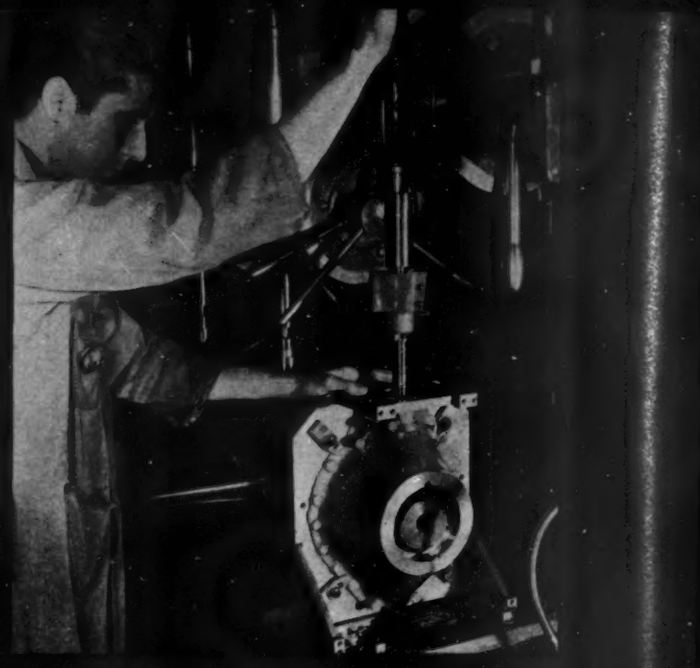


Fig. 17—The crankcase front is located by its contour for boring the vertical drive shaft hole

Fig. 18—The jig in Fig. 17 is turned on its side for drilling gear-shaft and flange-bolt holes in the crankcase end sections

Fig. 19—The crankcase rear is positioned by its contour in a jig for drilling and reaming dowel, gear shaft and flange-bolt holes

The fixture shown in Fig. 4 is then used for drilling 48 holes, eight at a time, for the cylinder attaching studs. These cylinder pad holes are then counterbored, and one hole in the No. 6 cylinder pad and one hole in the No. 1 cylinder pad are reamed to a 0.453 ± 0.005 in. for locating the housing in the fixture shown in Fig. 21 for milling sides, pad faces, and centerbore for camshaft bearings.

Oil pipe holes are then drilled and tapped and countersunk; then 32 flange holes are tapped.

The cambox cover is leveled in a fixture for rough and finish milling on the Cincinnati Hydro-Tel. Afterwards, the cover is located in a jig by two 0.188 ± 0.000 in. dowel holes, and 32 holes $\frac{13}{32}$ in. diameter are drilled through for the housing studs. The 32 flange holes are counterbored on the flange face, and the bosses on the top of the cover are spot faced.

The camshaft housing is then placed in the fixture shown in Fig. 22, for boring the bearing caps. It is located in this fixture by dowels which fit into the two stud holes reamed to 0.453 in. in No. 1 and No. 6

cylinder pads. The boring bar *A* is then set into position and clamped by swivel studs *B*. Then the bearing caps *C* are bolted in position and the bearings bored to size.

Cylinders and Cylinder Heads

The cylinder heads are cast aluminum alloy with integral fins. They have hemispherical combustion chambers, which are screwed and shrunk on the barrels. Aluminum bronze valve seats, one intake and one exhaust per cylinder, are shrunk into the heads, and two sparkplug inserts are shrunk and screwed in and pinned. Bronze valve guides are also inserted during the shrinking operation.

The head casting is chucked in a turret lathe in line with a center punch mark on a boss cast between the rocker-box pads, which boss is turned to 0.935 ± 0.001 in. after facing the rocker-box pad faces. The head is then clamped in a faceplate fixture in the turret lathe, using the 0.935-in. center boss as a locating point and the cylinder face is roughed and semi-finished. The thread diameter is rough bored and the hemispherical dome is rough turned in the same fixture, leaving $\frac{1}{32}$ in. for finishing.

The castings are then placed in jig shown in Fig. 23 for drilling cambox-pad holes.

This fixture consists of a frame *A*, guide plate *B*, plunger *C*, and operating lever *D* which moves plunger *C* vertically through an eccentric. The 0.935 in. boss between the cambox pads fits into a recess in plunger *C* and as the latter raises the head against the guide plate *B*, the head is positioned by its contour fitting against the guide plate. Eight holes are then drilled simultaneously in the cambox pads; two of the holes at diagonal corners of the pads are reamed to 0.251 + 0.005 in., and used in all succeeding operations for locating the head in fixtures.

The face of the intake port is machined on a Van Norman miller using the fixture shown in Fig. 24. This fixture is similar to the one shown in Fig. 23, the head being positioned by the boss between the cambox pads on a plunger which raises the head against the upper contour locating plate. A 4-in. fly cutter with carbide inserts is used for making the cut. The same set-up is used for facing the exhaust port. The 0.935-in. center boss is then removed in a jig wherein the head is located by the two 0.251-in. dowels holes in the cambox pads.

The guide bosses on the exhaust and intake ports are drilled, reamed and counterbored; holes are drilled and tapped on the exhaust and intake flanges; spark plug holes are drilled and tapped in fixtures similar to the one shown in Fig. 25. The heads are placed in the fixtures, with the 0.251-in. holes set over dowels in the base of the fixtures, and are clamped in place with swiveling cover plates having quick-acting lever clamps or bolts.

The last operation on the cylinder head is finishing the hemispherical dome and cutting the threads for the cylinder barrel fit. This is shown in Fig. 26.

Fig. 21—After locating by dowel pins, the camshaft housing is held by six eccentric clamps for milling the sides, bearing faces, and center bore

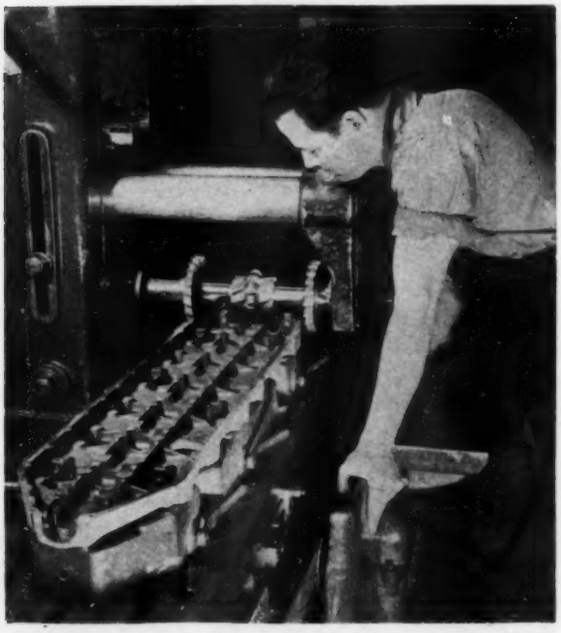


Fig. 20—The flange and cylinder pad faces of the camshaft housing are milled at a feed of 10-in. per min. with a 10-in. fly cutter

Fig. 22—The boring bar in the upper half of the jig swings down, and is secured by swivel bolts. The bearing caps are bolted in place for boring

Fig. 23—Holes in the cylinder head rocker-box pads are gang drilled. The head is raised by a plunger against the guide plate

Fig. 24—Intake and exhaust port faces are milled in this jig, which is similar to the one in Fig. 23

The head is set in the faceplate fixture and located by the two 0.251-in. dowels holes in the cambox pads. When so located, over-arms on the fixture are swung into place and bolted. After taking a finishing cut on the thread fit and dome, the threads are cut.

The cylinder barrels are machined from chrome-molybdenum steel forgings, the fins being machined integral. The skirts project into the crankcase and each barrel is secured to the lower half of the crankcase by eight hold-down bolts.

As shown in Fig. 27, each cylinder barrel is finish bored with three cutting tools *A* set in the boring bar *B*, which is guided by pilot *C*. The flange *D* is rough turned to diameter by tool *E*, while the skirt end *F* of the barrel is rough turned by tool *G*. The end of the barrel is faced by tool *H* when the boring is completed. The flange *I* is turned to $\frac{1}{4}$ in. width by tools *J*, which also undercuts the barrel back of the flange. A Potter & Johnson semi-automatic is used for these operations, which leave 0.020 in. on the inside of the barrel bore for grinding after shrinking the barrel on the cylinder head.

The barrel is then placed on an expanding arbor in a Warner & Swasey turret lathe, with the thread end away from the chuck. The thread end is faced, holding a precise distance between this end and the flange. The outside diameter on the fin section is finish turned to $5\frac{7}{32}$ in., and the barrel is under-

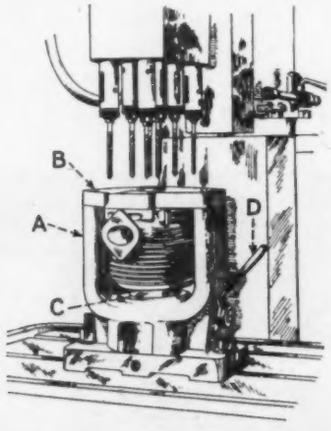


Fig. 25—Flange, spark-plug and port holes are drilled, reamed and counterbored in fixtures such as the one shown here. The head is located on dowel pins prior to bolting the swivel cover plate that prevents movement on the part

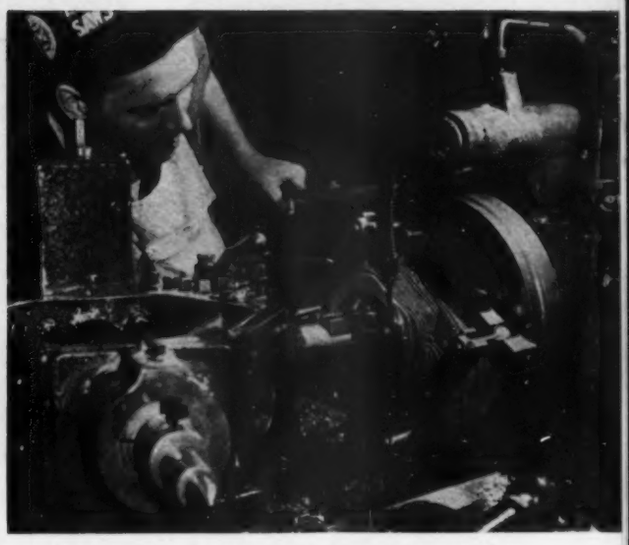


Fig. 26—The cylinder head is finish faced and bored, the hemispherical combustion-chamber dome is formed, and the threads for the barrel fit are machined in this set-up. A similar fixture is used for roughing cuts

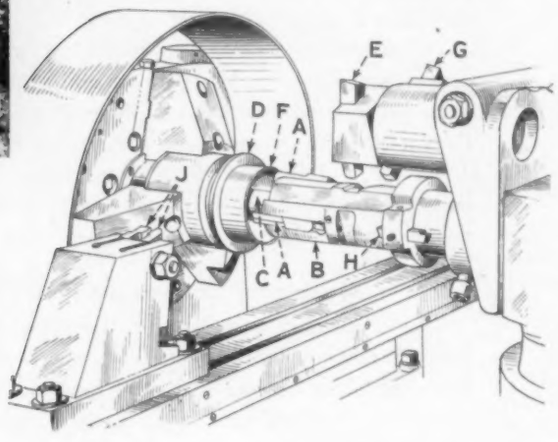


Fig. 27—This tool set-up is used for boring and turning the skirt end of the cylinder barrel

cut at the thread and skirt ends adjacent to the fin section. These operations are shown in Fig. 28.

The fins are cut on the barrel in a 12-in. Fay automatic as shown in Fig. 29. The barrel is loaded on an expansion arbor with the thread end out, and the fins cut with gang tools. Following this operation, the barrel is set on centers for grinding the skirt, flange and thread diameters. After loading on an arbor, the threads for the cylinder head fit are finished in an Ex-Cell-O thread grinder, as shown in Fig. 30.

The final operations on the cylinder barrel is to face the skirt end to 6.313 in. from the flange face, chamfer the skirt end to 60 deg., form a 0.025-0.035 in. radius at the outer end of the pilot, and break the sharp corners of the fins and threads. All these are done on a 14-in. Springfield lathe.

Pressure-type cylinder baffles are used with these cylinders. Pressure baffling forces a high velocity flow of cooling air through and over the finning on the cylinders, the forward speed of the plane building up a positive pressure on the air intake side of the cylinders, and a negative pressure on the air outlet side of the cylinders.

The cylinder head is then assembled to the barrel, inserting at the same time the valve guides, the valve seats and spark plug inserts. The head is heated to 650 F, while the barrel and valve guides are chilled to 60-70 F. below zero. At these temperatures, the parts are assembled, the valve seat and spark plug insert added without chilling, and the assembly cooled in oil.

In the next operation, eight holes are drilled simultaneously in the barrel flange, with the set-up shown in Fig. 31. The dowel holes at diagonal corners of the rocker-box pads are again used in this jig for locating the cylinder. After the holes are drilled, they are back spotfaced to a depth of $\frac{1}{64}$ in.

Fig. 28—The cylinder barrels are set on an expanding arbor for turning the skirt and thread ends, under cutting, and finishing the fin section

Fig. 29—Integral fins are cut in the cylinder barrels on a Fay automatic. Following this the skirt, flange and thread diameters are ground

The cylinder flange is round up to this point, but it must be milled octagonal. This is done, two faces at a time, in the duplex milling machine using the fixture shown in Fig. 32.

In succeeding operations, sparkplug inserts are drilled and pinned in place, intake and exhaust valve seats are ground, the cylinder bore is ground in a Bryant internal grinder, and the bore is finished to 4.125 in. + 0.001 in. in a Hutto hone. Finally, holes are tapped in cambox pads, intake and exhaust flanges, and in the sparkplug inserts.

Machining Connecting Rods

The connecting rods are of I-section, machined from chrome-molybdenum steel forgings. Steel-back cadmium silver bearing shells are used for the main connecting rod bearings, while bronze bushings are used on the piston pin fit of the rods.

The flash on the wrist pin and crankshaft bosses, as well as on the I-section between the bosses, is removed by grinding. Each connecting rod is then loaded in the fixture, shown in Fig. 33, mounted on the table of a duplex milling machine, and the four boss faces are straddle milled. The base *A*, bolted to the table of the Fitchburg duplex miller, has two swivel clamps *B* and *C* pivoting about pins *D*. These clamp the connecting rod in V-blocks *E* by adjusting the screws *F*. Setscrews *G* are set with jam nuts so that the connecting rod is a sliding fit in the fixture. The upright legs on both ends of the fixture are milled to $1\frac{1}{4}$ in. width for cutter clearance when the table traverses the fixture and connecting rod during the milling operation.

The crankshaft boss is milled to 1.770 ± 0.002 in. while the wrist pin boss is milled to 1.406 ± 0.002 in. width, holding the distance of the crankshaft boss

Fig. 30—The cylinder heads are screwed and shrunk on the cylinder barrels. The threads on the barrels are cut with this Ex-Cell-O grinder

Fig. 31—Eight flange holes are drilled simultaneously in the cylinder assembly. Dowel holes in the cambox pads locate the assembly in this jig

to the wrist pin boss on each side to 0.182 in. ± 0.002 in.

Following this operation, the bearing cap bolt holes are drilled through the crank boss, and afterwards back spotfaced on both ends. These holes are drilled $\frac{23}{64}$ in., rough reamed to 0.368 in., and finish reamed to 0.375 ± 0.0005 in.

The crank boss is slit with a milling cutter to form the bearing cap, holding the cap and rod halves equidistant with respect to the forged radius of the crank boss. The mating faces of the cap and rod are lapped for flat finish, after which the radii between the I-section and the crank boss are milled for nut clearance when tightening the bearing cap bolts. The holes are counterbored with a pilot drill to $\frac{5}{8}$ in. diameter and a depth of $\frac{3}{4}$ in. from the parting face. Afterwards, they are countersunk 90 deg. by $\frac{5}{8}$ in. diameter, holding the $\frac{3}{4}$ in. depth.

The holes are then spot-faced to $\frac{3}{4}$ in. diameter and $\frac{7}{8}$ in. deep from the parting face, holding a $\frac{1}{32}$ in. corner radius. Then they are countersunk to remove burrs. The mating halves of the cap and rod are then assembled and the wrist pin and crankpin holes are drilled simultaneously; afterwards, they are rough reamed preparatory to finish boring. The drilling and reaming operations are done in the fixture shown in Fig. 34.

The connecting rod is set on spacer block *A* and *B*, and is locked in position by adjusting screw *C* to the end of which is attached a V-block. The crank end of the connecting rod is set in a stationary V-block. Tightening screw *C* locates the connecting rod beneath the drill bushings. The bushing for the crank end of the rod slides in the jig and is held against the crank boss by clamping plate *D*; upon removal of this plate, a spring raises the drill bushing for removal of the connecting rod. The V-clamp on the wrist pin end of the rod extends around the boss sufficiently far to prevent lateral movement during drilling.

A similar jig is used for reaming the wrist pin and crankshaft holes. The reamed sized of the wrist pin end is 1.14 in. ± 0.001 in., while the crankpin end is 2.390 in. ± 0.001 in. Following this operation, the wrist pin holes are chamfered $1\frac{1}{4}$ in. in diameter by 45 deg. on both sides.

Two rods at a time are then placed on a magnetic chuck with a 0.182 in. spacer under the pin bosses, and the crank faces are finished ground to required width.

A two-spindle Ex-Cell-O boring mill, with a fixture for holding the rods, is used to bore the wrist pin and crankpin diameters. The spindles of this machine, shown in Fig. 35, are spaced equal to the distance between the wristpin and crankpin center lines. The wristpin hole is finish bored to 1.156 in. ± 0.0005 in. diameter, while the crankpin hole is bored and finished simultaneously to 2.406 + 0.000 in. and — 0.0001 in.

Sufficient metal is removed from the wrist pin and crank bosses to balance each rod; however, the contour of the crank boss is first milled to a radius of $1\frac{23}{64}$ in. The rod is balanced by weighting it on a shadowgraph scale, shown in Fig. 36, which indicates on an illuminated graph the weight of each end above and below that specified.

Washers are assembled to the cheeks of the crank and wrist pin bosses, and thread protectors are

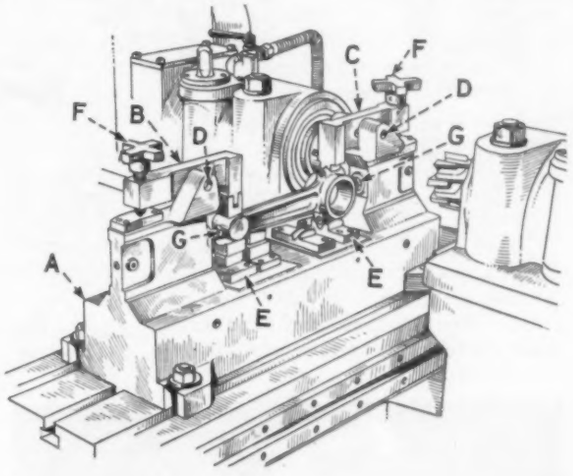


Fig. 33—Connecting rods are set in this fixture for milling the wristpin and crank bosses parallel. Afterwards the crank end is drilled for bearing cap bolts, and slit to form the cap

Fig. 32—The round flange on the cylinder barrel skirt is machined octagonal. The flange holes position the cylinder for this operation

placed on the bearing cap bolts. The rod is then sandblasted to a satin finish.

In succeeding operations, crank bearing dowel holes, wrist pin oil holes, and all burrs are removed from the surfaces of the rod. Finally the assembly is magnaflux tested for cracks.

This completes the operations of machine work on the major part of the ranger engine. Minor parts such as rocker arms, rocker pins, and rollers are also machined. The pistons, crankshaft, accessory drive shaft, camshaft and accessory parts are purchased. However, the crankshaft is balanced accurately in the shop before being assembled in the engine.

The crankshaft is a six-throw seven-bearing unit statically and dynamically balanced to close limits. Main journals and crankpins are hollowed and fitted with oil plugs. These plugs act as centrifugal oil cleaners and oil transfers from main bearings to crankpins. Crank cheeks are drilled for two-way feeding of oil from main journals to crankpins. The rear end of the shaft carries a Standard starter jaw, while the front end has a Standard No. 20 SAE spline for the propeller hub.

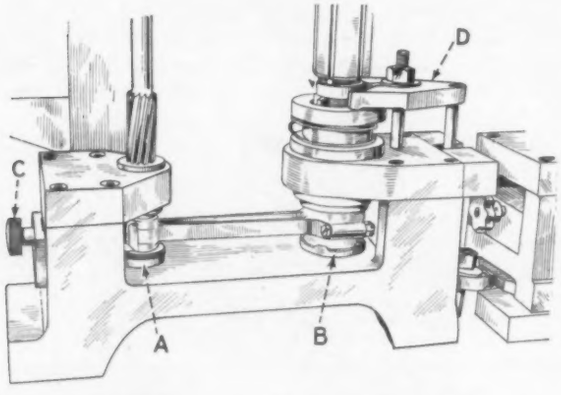


Fig. 34—Wristpin and crankshaft holes are drilled and reamed, leaving 0.010 in. for boring

The pistons are machined from aluminum alloy, ribbed for strength and cooling. Three $\frac{3}{32}$-in. compression rings, and one oil scraper ring at the bottom of the skirt are used. The wrist pins are of heat-treated alloy steel, hardened and ground. The pins are full floating and are retained by the snap rings.

The lubrication system is of the full-pressure type. A pressure pump with screens located on the crankcase rear section circulates oil through hollow engine shafts and cast-in passages, there being no external pressure oil pipes on the engine. Part of the oil from the pump is fed to the accessory drives in the rear section, the main supply entering the accessory shaft, which distributes it to the crankshaft bearings and connecting rods. From the front end of this shaft, oil is carried to all drives in the front section, and into the camshaft vertical drive shaft. Then, the oil flows into the camshaft, which distributes it to the camshaft bearings under pressure, and to the rocker arms and valve stems by spray from holes drilled in the camshaft.

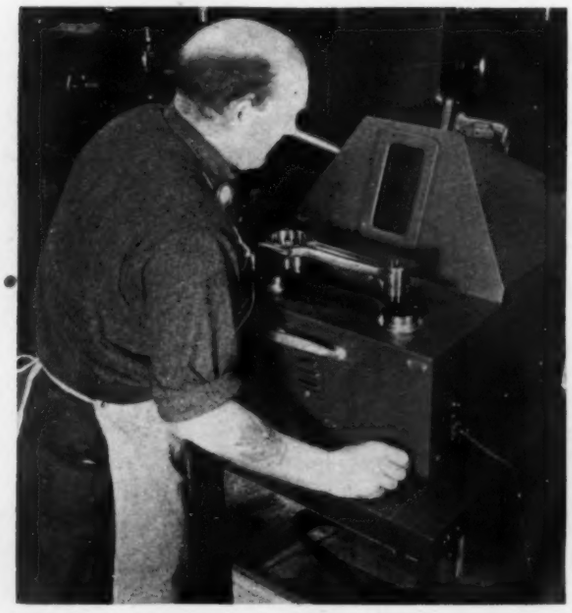


Fig. 35—Boring the connecting rod holes is done on this Ex-Cell-O machine, the spindles being set precisely on the center lines of the wristpin and crankshaft holes

Fig. 36—The balance of each connecting rod is checked carefully. The rods are weighed on this shadowgraph scale which registers the weight of the rod ends above or below specified limits

Hints on Die Making—I

BY ALBERT HUFF

MANY PAGES have been written on die design but very little on the actual manufacture of dies. The short cuts and hints mentioned here should be useful.

GRINDING

Always grind all six sides of die blocks prior to layout. This precaution will make for accurate measurements, particularly of unsymmetrical shapes, and for ease in laying out and in lining up parts. Though in some cases grinding may not seem necessary, forming the habit will considerably lessen the time needed to grind as repetition brings speed.

DRILLING

In laying out centers for holes, a square drawn to the diameter, as shown in Fig. 1, will show position and size of the hole more accurately than a circle drawn with dividers. A center punch a trifle dull or out of round, a divider leg not perfectly round and other combinations of errors will make a drawn circle inaccurate and eccentric.

For accurate drilling of holes from a center punch layout, start with a small drill (No. 50 or smaller) approximately the thickness of the web of the larger drill; drill deep enough to insure the larger drill having a good start. This practice serves to keep the large drill in position and gives an accuracy of about 0.002 in. It is not feasible to drill large holes, $\frac{1}{2}$ in. or more, in this fashion because the drill will not follow precisely a previously drilled hole even if it is just a trifle larger. The following method will make it possible to drill large holes accurately. Start with a No. 60 drill, drill and ream for a $\frac{1}{8}$ in. or $\frac{5}{32}$ in. hole. Make a special counterbore as shown in Fig. 2. Drill at least $\frac{1}{8}$ in. or $\frac{1}{4}$ in. deep, follow with the nearest size drill.

The special counterbore, Fig. 2, is made of drill rod, turned in the bench lathe at *A* to the size of the small pilot hole, and pilots the body *B* which is turned a few thousandths smaller than the finished size. The flats and the clearance are filed in the vise. It is then hardened and tempered, ready for use. This principle can be used for enlarging large holes, it is advantageously used for spring holes and in many other ways. Finish with the counterbore if necessary and ream (if an odd size hole) with a special reamer of the type shown in Fig. 3.

The gun reamer shown in Fig. 3A is also made of drill rod turned (*a*) to the correct size, the flat filed (*b*), and the clearance ground by hand. It is then hardened and tempered. These reamers hold their size remarkably well. The use of these reamers avoid the need of boring holes of odd diameters to size.

Special end mills and radius cutters, both concave and convex (see Figs. 3B and 3C) for odd sizes of slots (especially small ones) readily can be made by the adaption of these tools, which are really one tooth cutters. They are cheap and very efficient.

Another means for accurately posi-

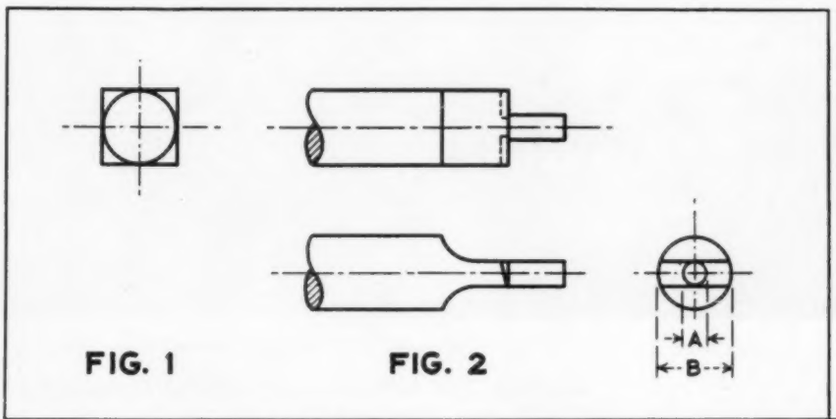


FIG. 1 FIG. 2

Fig. 1—A square drawn to the hole diameter will show the position and size of a hole more accurately than a circle drawn with dividers. Fig. 2—Special counterbores made from drill rod have many uses in the toolroom. Fig. 3—Small reamers, end mills and radius cutters also can be made from drill rod

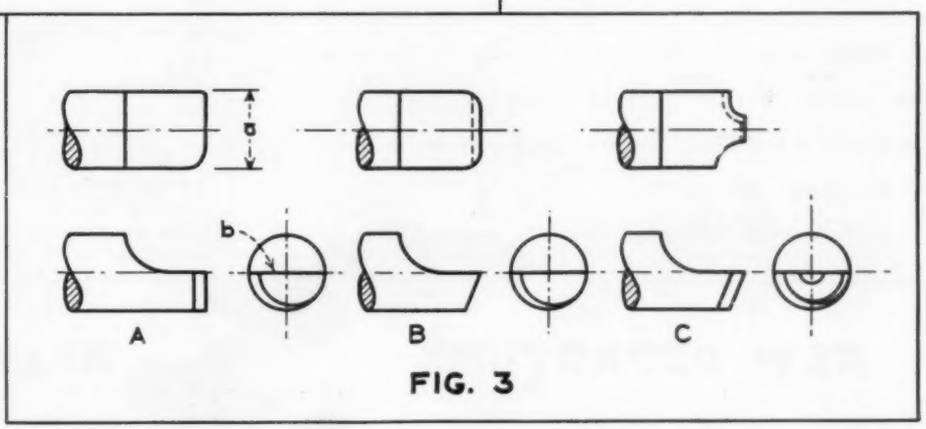
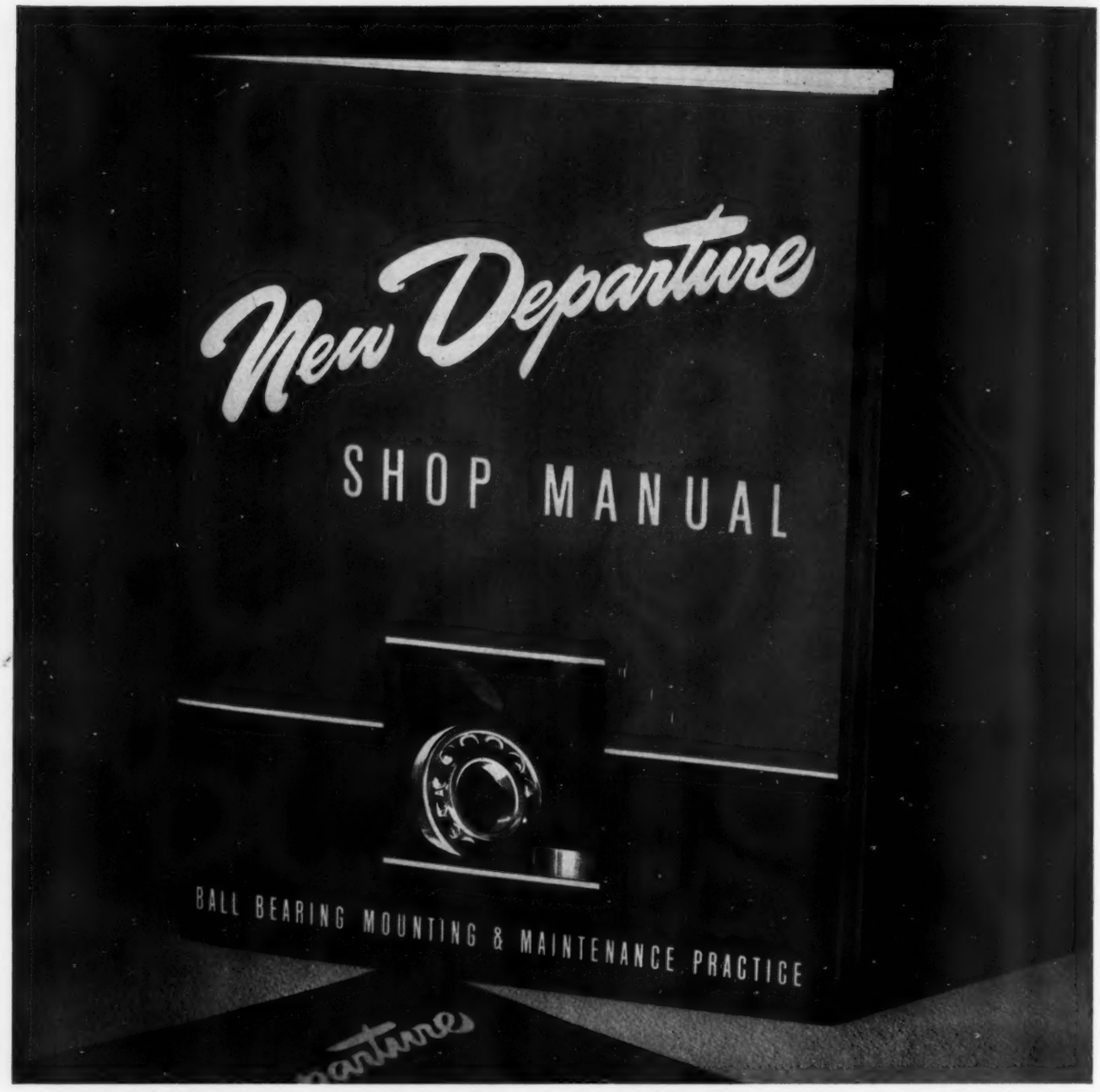


FIG. 3



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NEW DEPARTURE BALL BEARINGS

3010

Hints on Die Making—II

tioning holes (particularly small ones) is to use a jig block made of an accurately ground piece of steel with a hardened bushing pressed in it. This bushing has a hole about $\frac{1}{8}$ in. in diameter. A tight fitting pin is put in the bushing. The center distance of the bushing to the sides of the block being known, the jig can be clamped to the die block and positioned by the usual methods to the desired hole locations. The pin is removed and the die block spotted with a drill that also fits the bushing snugly, or the die block can be marked with an accurately ground center punch.

TEMPLETS

Always make a templet. In fitting a templet to the die, try it from the back. This will be faster because errors will be seen more easily and can be corrected before they reach the top of the die. Mark high spots with a red pencil.

A clamp similar to the one in Fig. 4 will aid in holding a templet in position for scribing. Scribers made of broken saw blades are excellent for the purpose.

Use blue vitriol freely to mark for machining and for high spots, especially when fitting a punch to a die. Low and high spots will be easily found by this simple means.

A piece of paper held lightly between a revolving milling cutter and the work will show the high spot easily. When the cutter starts to pull the paper, the cutter will be 0.003 in. (the usual thickness of paper) away from the work.

Scrapers made from worn files and to various shapes will aid in fitting punches and dies.

LINING UP PARTS

Drill all screw holes $\frac{1}{32}$ in. oversize. This makes it possible to shift and line up the parts easily.

Use of silk cloth in place of shims will aid in lining up punches and dies. Saturating the silk with oil will give it more strength. It is wise to leave the edges of punches a trifle dull and grind later.

To prevent the difficulty of driving dowels in position due to the buckling that occurs in hardening as exaggerated in Fig. 5A, the procedure shown at *B* often is used. By using a reamer at least 0.001 in. smaller than would ordinarily be used this effect can be corrected. After hardening, the expansion at the ends will make the hole larger. It is well to allow for this buckling when making clearances in blanking dies.

MISCELLANEOUS

An important rule to follow: Always lay out the position of the punch holder shank on the other side before drilling screw, dowel, and knockout holes. This will eliminate holes running into the sides of the shanks.

Form the habit of using a pencil to jot down tools needed at the tool crib. It will save many steps and time.

The use of adjustable parallels and planer gages will save a great deal of time in sizing slots and holes, and make it possible to take measurements from the sides of an irregular hole to the sides of the block.

The tool and die maker should have a knowledge of welding as the welding of punches to the punch pad has some advantages over inserting them by the usual methods.

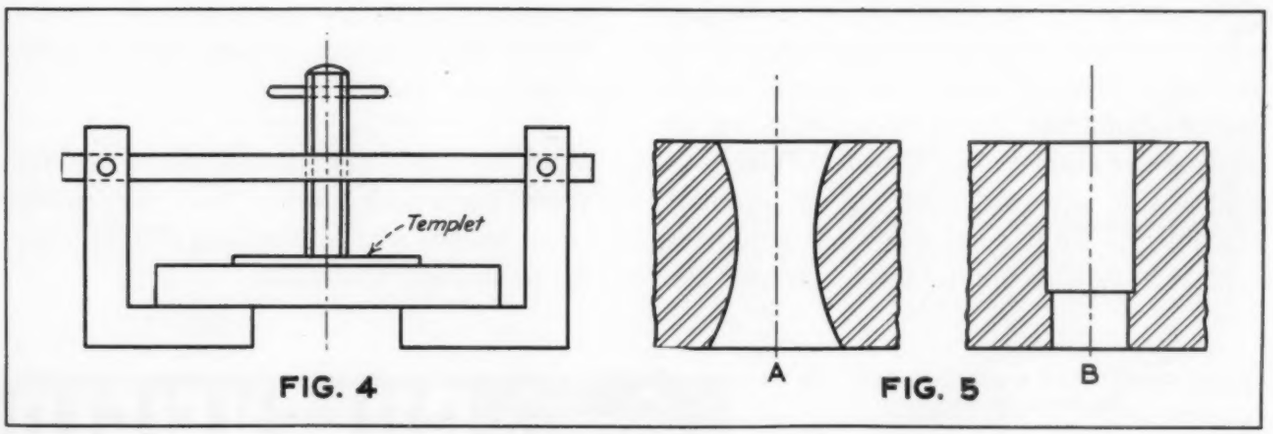
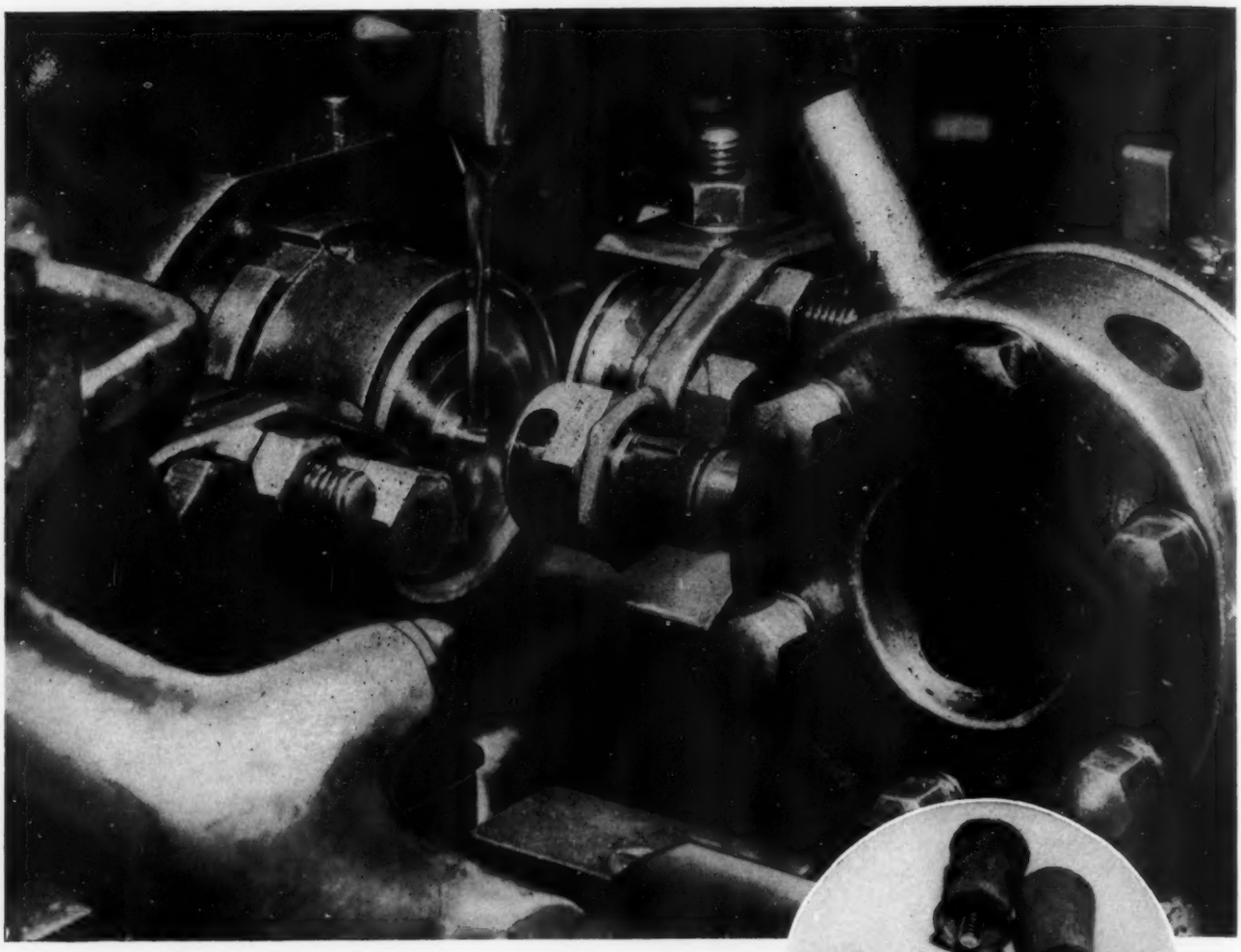
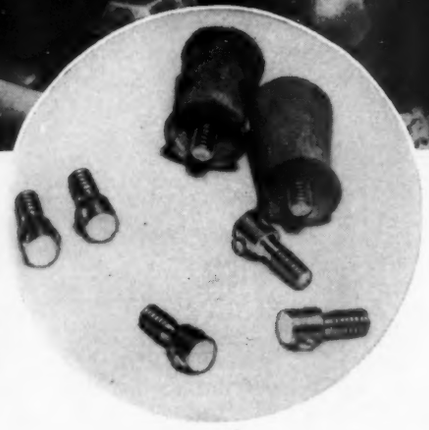


FIG. 4 FIG. 5

Fig. 4—Templet work can be speeded up by using a clamp. Fig. 5—To avoid difficulties caused by distortion of dowel holes due to hardening, as at A, use a hole drilled and reamed as at B





"Have Used 'Acorns' for 20 YEARS!"

SO said a big manufacturer when he gave us these pictures of dental polisher parts. We figure 20 years' loyalty to "*Acorn*" Dies is pretty significant. It is recognition of the leadership established by "*Acorn*" Dies in the field of fast, accurate threading on automatic machinery. This particular job is cutting 1-72 M.S. threads and by using "*Acorn*" Dies at 2420 R.P.M., he turns out 900 per hour. The average production runs well over 10,000 parts per "*Acorn*" die.

Working with this manufacturer for many years has enabled us to meet his changing requirements with a minimum of disruption to his production schedules.

GREENFIELD TAP & DIE CORPORATION
Greenfield, Massachusetts
DETROIT PLANT: 2102 West Fort St.
WAREHOUSES in New York, Chicago and Los Angeles.
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GREENFIELD TAP & DIE CORP. OF CANADA LTD., GALT, ONT.

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TAPS · DIES · GAGES · TWIST DRILLS · REAMERS · SCREW PLATES · PIPE TOOLS

Right Man For the Right Job

ONE MISTAKE which must be avoided is putting men into the Army who can better serve their country otherwise. We refer specifically to skilled factory workers and to technicians, including those who are nearing completion of their courses of study in engineering schools.

A delicate point admittedly is involved. It has been the habit in the past to look upon the "stay-at-homer" as shirking his military responsibility. Wars were fought exclusively by armies and navies, and you were safe from bodily danger so long as you remained a reasonable distance away from the site of battle.

But total war as it exists today changes all that. A speaker just returned from England said that there the least perilous job is as a soldier in the army quartered in the British Isles for defense of the country against possible attack. The most hazardous task is that of the RAF, the next most hazardous is that of Britain's gallant seamen, the third falls to the lot of the civilian population, and at the bottom of the list is the army.

Wars today are as much economic struggles as military. And in this age of mechanization the men in the factories count equally with the soldiers in the field. The war may well be won by America's industrial plants rather than by the prowess of an army.

This is why it is so terribly important that selective service be truly selective and not merely an indiscriminate draft of manpower. Selective service should mean choosing the right man for the right job, whether it be in the army or in a factory. The worst thing that could happen to our rearmament effort would be for our plants making critical materials and equipment to be stripped of competent workmen.

We have a hunch that district and local draft boards will be reasonable, provided that the problem is put up to them fairly. They cannot grant blanket exemptions or deferments. The manufacturer who requests such exemptions because he is making a defense product is doing the wrong thing, and he won't be able to get away with it.

He should be willing to give up voluntarily the man who can be replaced without too much trouble. When the case of an essential employee arises, he should present all the facts about the man's occupation and tell in detail why he is so valuable. Each case should be submitted to the draft board on its individual merit. If this procedure is followed, we believe that board members will not deprive a manufacturer of an employee whose loss would retard defense effort.

A word about technicians. Nowhere is the shortage so acute as among engineers and competently trained technical men. We quote the conclusions of the New York Committee on Engineering Training for National Defense, "Even if the engineering colleges themselves speed up production, teaching through the summer of 1941 and graduating men in February who might have stayed in college until June—even if training by shop schools facilitates an up-grading of plant personnel; even if the draft does not take the many engineers for whom industry does not ask deferment—even if all these reliefs are to be had —there will still be *an appalling shortage of technically trained men.*"

All the more reason why the members of the junior classes at engineering schools, if old enough to be subject to the Selective Service Act, should be permitted to complete their courses of study and then go immediately into the ranks of essential industries where application of their training will do the country the most good.

Burnham Finney

GAGING BUSINESS

New billions poured into armament as bomber program gets under way. Pipeline planned to relieve shipping puts another load on steel industry. Additions to railway equipment scheduled

Expansion of facilities to handle the huge new government program for bombing planes is occupying the main attention of a large segment of the metal-working industry. This program is so vast that it will mean a 50 per cent increase in output of many companies in the aircraft parts business. Enlarged operations will be achieved by farming out a substantial portion of the new load, though some plant construction is contemplated. Plenty of government money, at least three billion dollars, is available now for the building of more munitions factories necessary to meet the speeded-up timetable and expanded program formulated in Washington. That is on top of the billions already contracted for in new plants.

Machine Tools—Shipments of machine tools in April are estimated at $60,300,000, compared with $57,400,000 in March and $54,000,000 in February. In the January-April period the industry's production was double the volume for the same period a year ago. It is considered likely that the stimulus of new defense projects will raise the industry's operations to a basis of $900,000,000 a year by the end of 1941. The bomber program alone is now believed to require upwards of $400,000,000 worth of machine tools which must be ready for production by July 1, 1942.

To aid machine tool builders in expanding production to meet bomber manufacturing requirements without having to wait for formal orders, a pool of $200,000,000 has been established from which so-called floating orders will be allotted for the production of critical machines. The urgency for more anti-aircraft guns had made it necessary to take machines originally destined for other defense contractors, off the assembly floors of machine tool builders and send them to gun makers.

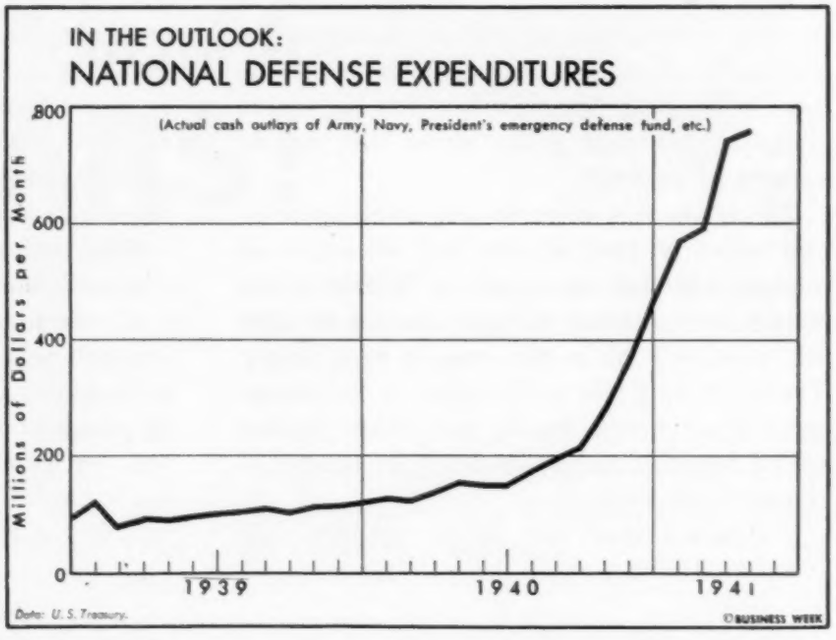
Railroad Equipment—With 67,727 freight cars on order, more than at any time since 1925, and 438 locomotives, more than at any time since 1926, the railroads are trying desperately to meet the pinch that is coming this fall. Some 25,000 freight cars were placed in service during the first four months of this year with 100,000 new cars scheduled for service by the end of the year. The Association of American Railroads at its Chicago meeting announced plans for building 270,000 freight cars, costing approximately $756,000,000, for delivery during 1942 and 1943. The program should be within capacity providing priorities for steel are furnished and the armament work which many of the companies have taken does not interfere. Railway equipment manufacturers have contracted for two-thirds of the orders for Army tanks amounting to $183,950,000; this does not include figures for 500 British tanks which the Pullman Company is building. Recently announced: New York Central is buying an additional $11,500,000 worth of equipment, bringing its total since January 1 to $26,500,000.

Steel—Running 22 out of 23 blast furnaces, Carnegie-Illinois is at the highest rate and tonnage capacity ever. It is reported that some railway car builders may not be able to get steel to meet their June commitments. Construction of the proposed oil pipe line from the mid-continent fields to the Atlantic coast would require 500,000 tons of steel. The line can be built in nine months or less. Congress will pass necessary legislation granting right of way, but according to present plans the line will be built privately.

Farm Equipment—Cleveland Tractor has received a $2,000,000 order for 260 high-speed tractors for use by the Army Air Corps. International Harvester reports that military contracts will comprise about 20 per cent of that company's estimated 1941 output. Orders now total $60,000,000. The demand for farm machinery continues strong. Since farm equipment manufacturers are large users of steel, these companies are searching for substitutes.

Aircraft—The bomber program calls for expansion of engine plants and propeller factories to a base where in 1943 a monthly output of over 12,000 engines will be attained. This would indicate that the plan for building 500 bombers a month is only the initial step toward an ultimate output of several times that volume. New sources of airplane engine manufacture are being arranged for. Chevrolet Division of General Motors, for example, will make the Pratt & Whitney Engine. An order for $32,913,000 worth of airplanes and parts has been awarded to Vultee Aircraft. Other companies granted large contracts for aircraft and parts are Curtiss-Wright, $2,440,000; Fairchild, $4,747,000; and Ryan, $4,134,000.

Munitions—Orders for machine guns for mounting in aircraft both for the United States and Great Britain take priority over machine gun production for all other purposes. Full quotas of machine guns for maximum authorized infantry, armored units and other branches of the service will take their turn with other munitions. Consolidated Steel Corp. has been awarded a $9,186,000 contract for ordnance equipment.



National Defense expenditures continue to rise at a fast rate. Last November monthly expenditures were $375,900,000 but have doubled in five months with April expenditures totalling $761,000,000. It won't be long before expenditures reach the billion-a-month mark

Previous Confusion in Defense Taxation Cleared; Explain Plant Certificates in Use

WASHINGTON—The intricacies of defense taxation are gradually being straightened out. Most of the trouble has been in connection with the conditions attached by Congress last fall to the provision for rapid amortization of defense plant. Essentially, Congress said that a defense contractor, in computing his taxable income, might deduct from his gross income each year a fifth of the cost of new plant. However, it was specified that this could only be done if the new plant was necessary to defense and if any government equity in the plant arising from "direct or indirect" reimbursement of the contractor was adequately protected.

To comply with this rather puzzling law, the Defense Commission invented three types of certificates. First, a Certificate of Necessity stated that the new plant is in fact necessary to defense. Issuance of these certificates was for some time delayed by mere mechanics, but the commission is now pretty well set up to date, having acted on roughly 1,700 of 2,600 applications.

Interpretation on Reimbursement

On the matter of reimbursement, more complicated questions of interpretation arose. It was early decided that if a contractor is not being reimbursed by the government for the cost of his new plant, he should receive a certificate to that effect, a Certificate of Non-Reimbursement. And if he is being reimbursed, he should get a Certificate of Government Protection certifying that the equity of the government in his plant is protected.

Neither of these certificates is essential, but without them a contractor would have the job of demonstrating his eligibility for rapid amortization to the hardboiled Bureau of Internal Revenue.

The difficulty was to decide what constitutes reimbursement. Army and Navy were inclined to assume that if a manufacturer didn't have any formal plant-financing contract he wasn't being reimbursed and was entitled to a certificate. The Defense Commission had scruples about this and wanted to be assured that the price of goods manufactured in the new plant hadn't been jacked up to include amortization of the plant cost. Months of delay ensued while this disagreement was thrashed out, and at the end of April only three Certificates of Non-Reimbursement had been issued out of nearly 1,400 applications.

The bottleneck was broken this month when Army and Navy agreed that reimbursement is a cost accounting matter, and certificates are now being issued rapidly. Procedure is to determine from contract data whether the price of the goods includes more than "normal" plant depreciation. If Army and Navy files do not yield this information, the contractor will be required to submit supporting data on his application for a certificate.

If it is found that the price is such as to reimburse the contractor for his new plant, then, to quality for tax-amortization privileges, he must obtain a Certificate of Government Protection to show that the government's equity in his plant is protected. How this shall be done has not yet been decided, but the method being considered is to require, as a condition for obtaining a certificate, that a clause be inserted into the supply contract under which the plant, for which reimbursement has been received, will be turned back to the government after the emergency; the contractor would have the option to buy the plant from the government at a depreciated value.

How much harm the delay in straightening out these questions has done is impossible to determine. It chiefly effects the comparatively small volume of expansion which has been privately financed. Even in this case, the delay has not cost anyone money, since lack of a certificate will only cause trouble when the Treasury gets around to questioning deductions claimed in tax returns.

New Priorities Plan Aids Acquisition of Materials

WASHINGTON — The Defense Supplies Rating Plan, a new priorities plan for speeding defense production designed to give specified manufacturers of "off the shelf" supplies a preference rating for the acquisition of scarce materials entering into defense work, has been instituted by the OPM. Manufacturers who are granted the use of the plan will estimate the proportion of their total production which goes into defense channels and then will be given an A-10 rating.

Thus a plant which is engaged 60 per cent in defense and 40 per cent in non-defense work may get an A-10 rating which will apply to deliveries of scarce materials flowing into its defense orders. The plan is designed primarily as a solution to the problem of those producers who do an "off the shelf" business calling for immediate delivery. Such producers will be assisted by this plan in maintaining a steady flow of necessary materials which they will use in the production of defense items.

For the present the method will be tried experimentally with a restricted list of about 500 producers of: industrial motors (from 1 to 200 horsepower), cutting tools, portable tools, hack and band saws, lathe tools, barrels, socket screws, roller and silent chain, and scientific instruments.

Gunners in Glass Houses—*The American Bomber, the Martin B-26, is equipped with a Plexiglas nose, rear gun turret, observers dome, and four fuselage windows such as the plastic globes above which are made from such opaque materials as coal and oil. Resembling the dome of an astronomical observatory, the inclosures are designed to permit the swinging of the plane's guns like observatory telescopes in any direction*

Defense Needs Hold Attention of A.M.A. Production Conference Held Last Week

NEW YORK—A frank swapping of ideas concerning problems of defense production was the purpose of a conference of the Production Division of the American Management Association, held at the Hotel Astor, May 21-22. Raymond S. Perry, vice-president, The Ingersoll Milling Machine Co., conducted an all-day symposium on the subject of machine and man power limitations. Representatives of 16 manufacturing concerns contributed their personal experiences to this session, telling how they were able to meet emergency demands with limited additions to their equipment.

Typical of the ten-minute talks on this subject was that of H. L. Consley, assistant works manager, York Ice Machinery Corp., who told how his concern had effectively increased the output of sheet-metal parts by planning five of the eight operating functions that were formerly placed on the shoulders of the man on the job. Experienced sheet-metal men worked with the company's engineers to draw up specifications and blueprints that made possible the employment of men without previous experience in this work.

Dave M. Strauchen, superintendent, Cincinnati Milling Machine & Cincinnati Grinders, Inc., explained the use of the inventory control chart and the shop load chart to prevent clogging of materials and to bring parts to the assembly department as required. Improved shop layout is an important factor in the success of this procedure.

A single shift of ten hours gave an average increased production of 25 percent over two 8-hour shifts according to W. C. Zinck, factory superintendent, North & Judd Mfg. Co. His concern used experienced diesetters to train additional set-up men, materially reducing down time on machines. The use of men-and-machine charts to eliminate idle time was described by Clifton H. Cox, industrial engineer, Johnson & Johnson. Illustrating an actual case history with moving pictures, he showed how machine time was doubled and the operator's time increased materially by a simple change in operation. Other speakers gave equally striking statements of drastic improvements in output employing, for the most part, facilities already available.

The second day of the conference was devoted to four sessions, two in the morning and two in the afternoon, covering topics of timely interest. A. R. Glancy, chief of ordnance for OPM, assisted by Joseph L. Trecker, chief, Sub-Contracting Unit, OPM, conducted a meeting on subcontracting. The discussion got down to actual cases as to how to get subcontracts and their effect on regular business.

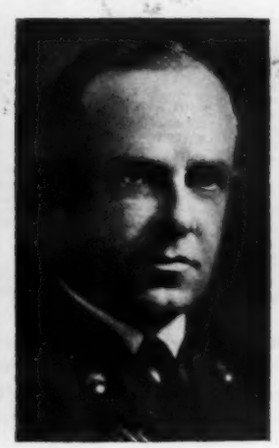
A simultaneous session on quality control was conducted by T. O. Armstrong, supervisor of industrial relations, Westinghouse Electric & Mfg. Co., with W. C. Schneider, chief inspector, The Greist Mfg. Co., acting as technical adviser. Ways and means of eliminating spoilage and waste was an important theme of this meeting.

At a luncheon session, Lieut. L. H. Campbell, Jr., Brigadier General, Office of the Chief of Ordnance, U. S. Army, was introduced by D. F. Carpenter, vice-president and director of manufacture, Remington Arms Co. General Campbell's subject was "Musts About Materiel," and he told how manufacturers could assist the Ordnance Department in meeting the Army's urgent materiel needs. He outlined the various ways of placing army contracts and gave some practical advice in avoiding the blind alleys of Washington.

An afternoon session on work simplification was conducted by W. W. Aulepp, General Foods Corp., assisted by Allan H. Mogensen. Mr. Mogensen showed films giving results of work simplification in many types of plants. A simultaneous afternoon session on industrial training was held under the chairmanship of R. C. Oberdahn, director of training, Calco Chemical Division, American Cyanamid Co. Glenn Gardiner, assistant to president, Forstmann Woolen Co., acted as discussion leader. Each told what they have been doing in the Training Within Industry activity as a preliminary to the general discussion.

Addressed A.M.A. Conference *Meeting Chairman*

D. F. CARPENTER



BRIG. GEN. L. CAMPBELL, JR.

RAY PERRY

C.I.O. WINS FORD ELECTION

DETROIT—When the United Automobile Workers—C.I.O. won an overwhelming victory over the A. F. of L. for the right to bargain exclusively for the 80,000 workers in the Ford Co.'s River Rouge and Lincoln plants, last week, it brought the last member of the "Big Three" into the folds of unionism. General Motors and Chrysler signed contracts with U.A.W.-C.I.O. in 1937 after bitterly fought strikes. In the election, held under the supervision of the National Labor Relations Board, C.I.O. polled 51,866 votes in the Rouge Plant, or 69.9 per cent.

Legislate for Priorities As OPM Retains Control

WASHINGTON—The Vinson priorities legislation, in the form in which it passed the Senate, will not substantially change the direction of priority action. Its main purpose is to give clear legislative authority to existing procedures which either have no legal backing or a very strained one. It will mark the final death of the "voluntary" priority, which has long been voluntary in name only. These have been used for all priority action which went beyond the original authority to give preference to Army and Navy orders. The bill will also remove the threat of litigation from firms who have had to violate contracts in order to comply with voluntary priority ratings.

The Cox amendment, approved by the House but thrown out by the Senate, would have set up the Priorities Division as an independent statutory body, its administrator appointed subject to the approval of Congress. Although technically indefensible—since it would have ripped priorities away from coordination with other phases of industrial mobilization—it was symptomatic of growing disquiet in Congress over the gravitation of control over industry to executive fiat. It represented too an effort to freeze in their places the businessmen who now operate the priority system and prevent absorption of that critical power by the New Dealers in the Office of Price Administration and Civilian Supply.

MAY INCREASE STEEL

NEW YORK—"Some enlargement of existing steel capacity may be necessary to meet future demands," indicated Irving S. Olds, chairman, U. S. Steel Corp., in an address before the American Iron and Steel Institute's fiftieth general meeting held at the Waldorf Hotel last week. However, he called for caution in formulating any expansion plans as he expected the steel industry to supply all demands on the basis of past performance. Walter S. Tower, re-elected president of the Institute during the meeting, warned against the contention of some Administration economists that defense, plus British, plus civilian demands for steel in 1942-43 would exceed industry's 1943 capacity by anywhere from 10 million to 30 million tons of ingots. Sir Gerald Campbell, British Minister to the U. S., who addressed the meeting, said that economic and social equality will inevitably be the aim of post-war Britain.

U. S. Ship Acquisition Program Gains Momentum

WASHINGTON — When the House passed unanimously a bill authorizing President Roosevelt to acquire 59 new naval auxiliary vessels at a cost of over $300,000,000, it marked another milestone in the U. S. program, which calls for the acquisition of the greatest collection of ships the world has ever known. Naval experts believe that many more auxiliaries will have to be added to the fleet before the two-ocean navy is in existence, but when these 59, totalling about 550,000 tons, are added this summer, the U. S. Navy will have some 397 auxiliaries of about 1,652,181 tons.

The step-up in U. S. shipbuilding is indicated in a number of active ways as of May 1, 1941, compared to December, 1940. At present 155 ways are active in shipyards over the country, compared with 100 active ways in December 1940. At present 144 new ways are projected and are being added to the active list weekly.

In December 1940, there were 53 active ways capable of building ships 300 ft. and over in North Atlantic U. S.; 12 in South Atlantic; 8 on the Gulf Coast; 10 on the Pacific Coast; and 17 on the Lakes. As of May 1, 1941 the number of active ways has increased to: North Atlantic, 66; South Atlantic, 22; Gulf Coast, 26; Pacific Coast, 25; and the Lakes, 17.

Meanwhile the U. S. Maritime Commission reports that first ship deliveries on the 200 cargo vessels for the U. S. and the 240 ships for Britain will begin in November.

Louis Poock Dedicates New $1,000,000 Plant Of Sheffield Corporation at Dayton, Ohio

DAYTON—Before high-ranking Army officers and government officials, Louis Poock, president and general manager of Sheffield Corp., formally dedicated the new $1,000,000 gage plant on May 16 to the national-defense effort and the future well-being of the country. Heading the large Army representation were Brig. Gen. G. M. Barnes, assistant chief of the industrial engineering service, and Brig. Gen. W. P. Boatwright, commanding officer, Frankford Arsenal. Mason Britton of the tool section, OPM, sent a congratulatory telegram taking note of the importance of the occasion, as being a long step forward toward relieving the congestion in the gage industry.

Sheffield's new plant represents that concern's part in the 100 per cent expansion suggested by the government to the four leading gage-making establishments, of which the Dayton concern is the second largest in the country and the largest west of the Atlantic seaboard. Measuring 80 x 240 ft. and containing 35,000 sq. ft. of floorspace, the new plant adjoins the Cimatool establishment, also managed by Poock. Equipped with up-to-date machinery, air-conditioned, lighted by fluorescent lamps and even provided with air-raid protection features, the new structure is ideally arranged for the exacting requirements of gage manufacture.

The growth of the Sheffield Corp. is best illustrated by two facts: (1) it was started in 1916 in a small way to manufacture industrial gages for the Canadian government then at war with Germany; and (2) since 1933 under the dynamic influence of Louis Poock, gage output has been trebeled, and now 700 men are at work in the new plant. Within a few months the full working force of 1,000 will be employed. Since qualified toolmakers who can undertake the additional training for gage making are practically nonexistent, Sheffield has accelerated its trainee program during the past eight months.

Government officials stated privately to AMERICAN MACHINIST that the needs of the government have grown so rapidly that at the present time the demand for thread gages exceeds by 60 per cent the planned output of the industry on Dec. 1, after taking into account the 100 per cent expansion now reaching its final stages. Further expansions in the gage industry are now under discussion, despite the difficulty of digesting untrained workers.

High ranking defense officials inspected the Sheffield Corporation's new $1,000,000 plant addition at Dayton, Ohio. Looking over the plant are, Lieut. Col. Fred McMahon, chief of the Cincinnati ordnance district (left to right, above); Edward Mueller, chief of the Cincinnati Post, Army Ordnance Association; Brig. Gen. G. M. Barnes, assistant chief, Industrial Service, Washington, D. C.; Brig. Gen. W. P. Boatwright, Commanding Officer, Frankford Arsenal; and Louis Poock, President, the Sheffield Corp.

Canada Takes Over National Steel Car Plant To Solve Labor Rift; U.S. Unions Gain Power

MONTREAL—The increasing power of U. S. labor unions over Canadian War plant workers is causing concern in governmental and industrial circles here. U. S. unions have gained greater power in Canada since the war started than they had been able to achieve in decades prior to this time. So far, the government, which has been given far-reaching war time emergency powers to prevent strike tie-ups in war plants, has used such powers sparingly against labor. However, the government has used its powers against corporation management as it set a precedent recently by taking over the Hamilton plant of the National Steel Car Corp., when the company refused to obey the orders of a conciliation board demanding temporary reinstatement of a discharged employee.

Company Refuses to Obey Order

In refusing to obey the conciliation board's order, National Steel Car Corp. officials stated that they took such action as a test case, evidently in the hope of bringing about a revision in present government arbitration rules. The dispute started when the SWOC notified the government that a strike would be called at the plant. Under existing regulations, any strike vote automatically results in the appointment of a conciliation board.

A labor showdown appears imminent. Before the conciliation board, the SWOC demanded reinstatement of an employee who had been discharged, according to the company, for staying away from his work, and because he had been convicted of fraud in the Ontario court. The company refused to reemploy the man and the SWOC called a strike at the plant. After a few days, despite the strike call, the company claimed that the plant was back to practically full production. However, the conciliation board demanded that the company reinstate this discharged employee, pending investigation of the case. The company refused, claiming that the government was being bluffed into subservience to the union. The government then took over the plant, claiming that the company was "unreasonable."

The seizure of the Hamilton plant is the first step of its kind in either Canada or the U. S. in the present war.

The Canadian government has assumed full authority to manage all phases of the plant's business and has installed A. J. Brunning, associate minister of munitions and supply, to operate the plant as controller. As a result of the controller's appointment, neither the Board of Directors, nor the share holders of the company shall be entitled, directly or indirectly, to manage, operate or carry on, or control, supervise the management, operation or carrying on of the business, undertaking, affairs and operations of the plant.

To date labor has avoided all penalties, chiefly because the union officials have heeded all demands made by the government. A number of strikes have been called in war plants, but have been ended when the government threatened penalties.

There is increasing concern over the problem of financing war costs. About 44 per cent of the national income will be required to pay this year's war expenditures. Although around 75 per cent of these war costs are to be raised from taxes, the government is just launching a campaign for a $600,000,000 war loan; it will have to float another big loan later in the year.

Canadian auto manufacturers must reduce their output of passenger automobiles during the production period from April 1 to December 31, 1941 substantially as compared to their production during the same period in 1940. The order, which does not include trucks or commercial vehicles, may cover a reduction as high as 20 per cent. The reason for the order is to conserve foreign exchange and make possible greater utilization of man power and equipment for war work. The manufacturers will be placed on a quota, and will be required to obtain licenses from the controller by May 31.

Stewart-Warner Delivers 3,000,000th Fuse to Army

CHICAGO — President Roosevelt on May 16, 1940, delivered his "call to arms" to Congress. Already underway, Stewart-Warner Corp. delivered its first fuses on a big U. S. contract of 205,000 to the Army one week later. On May 23, at a luncheon marking the first anniversary of this delivery James S. Knowlson, president and chairman of the board, indicated to Colonel Donald Armstrong, executive officer of the Chicago ordnance district and guest of honor, that the 3,000,000th fuse had been completed that day.

National Steel Car Corp. Will Build Martin Bombers

TORONTO—National Steel Car Corp., Hamilton, Ont., is retooling one of its plants to permit production of a new Martin bombing plane. The order, which amounts to approximately $18,000,000, is the largest contract so far placed in Canada for aircraft.

MACHINERY EXPORTS UP

WASHINGTON—U. S. exports of industrial machinery in March, 1941 were valued at $40,418,406, an 8 per cent increase over the February shipment, which amounted to $37,493,575, as reported by the U. S. Department of Commerce. Most important was a gain of more than $4,000,000 in the exports of metal-working machinery.

Exports of Machinery During March, 1941

	March 1941	February 1941	March 1940
Electrical machinery and apparatus	$11,558,112	$9,318,858	$10,335,418
Power-generating machinery, except electric and automotive	3,173,673	3,302,398	2,119,230
Construction and conveying machinery	2,944,385	3,456,285	3,223,837
Mining well and pumping machinery	3,941,353	4,435,487	5,245,434
Power-driven metal-working machinery	20,032,856	16,544,102	18,267,473
Other metal-working machinery	1,906,059	1,374,332	902,889

Metal-Working Machinery

Engine lathes	1,200,744	1,285,956	1,290,669
Turret Lathes	2,534,895	1,013,046	1,432,524
Other lathes	2,382	706,663	643,324
Vertical boring mills and chucking machines	639,585	776,873	797,520
Thread-cutting and automatic screw machines	1,426,085	900,552	1,761,598
Knee and column type milling machines	1,998,082	1,584,981	740,759
Other milling machines	1,918,919	1,571,516	1,185,203
Gear-cutting machines	422,501	358,975	735,039
Vertical drilling machines	495,652	408,157	329,164
Radial drilling machines	219,349	262,263	289,428
Other drilling machines	588,639	498,355	350,760
Planers and shapers	769,666	311,047	473,894
Surface grinding machines	452,148	338,069	550,668
External cylindrical grinding machines	769,511	779,617	379,553
Internal grinding machines	402,050	626,292	920,403
Tool grinding, cutter grinding, and universal grinding machines	604,957	531,023	856,532
Other metal-grinding machines and parts	476,284	563,030	845,701
Sheet and plate metal-working machines and parts	1,515,120	841,320	543,580
Forging machinery and parts	1,446,715	1,235,385	805,763
Rolling-mill machinery and parts	345,825	505,321	1,414,317
Molding machines	19,099	31,249	45,377
Other foundry equipment and parts	259,626	101,605	97,136
Other power-driven metal-working machinery and parts	1,513,889	1,309,443	1,765,351
Pneumatic portable tools	168,041	107,753	466,856
Other portable and hand or foot-operated metal-working machines and parts	226,620	177,764	150,283
Chucks for machine tools	63,028	57,071	38,717
Milling cutters, machine-operated threading dies and taps, and similar machine-operated metal cutting tools	726,552	495,447	88,336
Other metal-working machine tools and parts	721,818	536,297	158,697

INSIDE DETROIT

Auto industry continually planning ways to increase production of new items for defense. Nash-Kelvinator obtains new plant for propeller manufacture; G-M also expands propeller facilities

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT—Instead of marking time while digesting stupendous national defense assignments, the automotive companies are continually developing plans to take on additional items and to double or triple some of the programs approved only a few weeks ago. At the moment the enlarged bomber program—500 per month—is receiving intensive study, especially toward procurement of the additional engine and propeller manufacturing facilities.

According to well-substantiated reports, Chevrolet has been studying the production methods evolved by Buick for manufacturing the Pratt & Whitney 1,200-hp. radial air-cooled engine. Buick, is will be recalled, is equipping a $31,000,000 plant at Chicago for producing 500 of these motors per month by mass production practices that draw freely upon automotive experience. It has been learned authoritatively that Chevrolet has not received a letter of intent from the government to go ahead with a similar engine project, but Chevrolet has been thinking about setting up an aircraft engine plant at Tonawanda, N. Y.

Nash-Kelvinator Expands Plant

Nash-Kelvinator has taken over 400,000 sq. ft. of floorspace acquired by the Defense Plant Corp. from the Reo Motor Car Co., Lansing, and will spend $8,000,000 for equipment with which to manufacture Hamilton Standard propeller and hub assemblies. It is reported that these assemblies are of a recently designed type for application to large planes for the Army and Navy. Between 2,000 and 3,000 employees will be needed when the plant is in full operation. Nash-Kelvinator production men are already supervising rehabilitation of the Lansing plant.

General Motors is also planning to expand its propeller manufacturing facilities at Dayton. Last June, Engineering Products, Inc., principally an experimental firm, was taken over and renamed the Aeroproducts Div. Personnel was expanded to complete the design of a new type hydraulic propeller, and plans were laid for a 193,000 sq. ft. building to employ 1,800 workers. These steps were taken before the propeller had passed acceptance tests at Wright Field. The line of Aeroproducts propellers has been approved and the new plant will commence operation this fall, two years ahead of a normal peacetime program. But the expanded bomber program will not permit the Dayton enterprise to remain at the original planned level.

Further evidence of the importance of the automobile industry in the aircraft procurement program is contained in transfer of the Central Air Corps Procurement District from Dayton to Detroit. Headquarters are being established in office space leased months ago at the Graham-Paige plant for the use of the disbanded Automotive Committee for Air Defense, and where a subsidiary Air Corps procurement office has been maintained by Maj. James A. Doolittle. The expanded force consists of 25 officers and 100 civilians under the command of Lt. Col. Alonzo M. Drake, district supervisor. The Central District will coordinate, facilitate and follow-up the procurement of aircraft, engines and material after the contract has been let. Part or all of 26 states, beginning with West Virginia and the western part of New York and Pennsylvania and extending to Colorado and Texas, are included in the Central District.

Detroit's casualness in starting projects almost "on faith" is one of the reasons why things get done in a hurry. Signed and sealed contracts are not custom; many an order is taken verbally, the written order coming through later. For example, everyone has known for months that Chrysler and affiliated companies are setting up plants to manufacture subassemblies for the Martin B-26 two-engined bomber. Yet the other day the company received its first aircraft contract—an educational order of approximately $5,000,000 with which to make nose and center-section assemblies.

Chrysler's part in the national defense program now approximates $200,000,000 but a monetary yardstick is unsuitable for appraising the various undertakings. Equipment of the tank plant is now 80 per cent installed, or almost double what it was six weeks ago. Obviously, a far-reaching worker-training program is involved before the three assembly lines function with 66 tanks in various stages of fabrication. Another Chrysler undertaking is the setting up of an aluminum forg-

AUTO WAGES HIGHEST

DETROIT — The auto industry maintains the highest hourly earnings of employees in U. S. industry, it was indicated by the U. S. Labor Department. The hourly ratings for industries are:

Industry	*Cents*
Automobiles	97.5
Paper & printing	80.3
Iron, steel & products	79.1
Rubber products	78.5
Machinery, excluding transportation	77.1
Chemicals, petroleum & coal products	77.0
Non-Ferrous metals	73.9

Harvester in High—*With farm tractors rolling off the end of the line at Rock Island, Ill., plant, International Harvester Co. (above) the concern announces that it will operate a new plant employing 1,500 people in St. Paul, Minn. for the manufacture of artillery. In six other plants of the company elections are due to be called any day by the National Labor Relations Board to determine union representation*

British Combine

Serious Business — *Canadian technical schools are building small model airplanes which play an important part in war. The models are used to teach student pilots of the RAF to identify readily all types of airplanes, both of the allied forces and those of the enemy. The models are designed to reveal vulnerable spots so the pilot may learn to maneuver to protect himself or to attack opposing machines*

ing plant for production of aluminum forgings for the Model B-26 bomber. Approximately $750,000 will be spent for equipment.

Opinions expressed in Detroit concerning settlement of the General Motors UAW-CIO dispute over a new contract run about as follows: (1) it will be almost impossible to stop the chain of ten-cent raises started by a steel company, and in fact it is suggested that heavy pressure was brought by government and union sources to prevent General Motors from breaking this precedent even though its wage structure was already the highest in the automotive industry; and (2) manufacturers might possibly save money if they can reach an agreement with the union over wage increases without letting the matter get to Washington. It is possible that General Motors could have reached an agreement in Detroit if it had been willing to start the ball rolling with more than the original offer of three to five cents more per hour, depending upon job classification. Naturally, the union would not retreat from its position of ten cents or else, when it found the green light set by government well-wishers.

Raise Granted on Capacity to Pay

The National Defense Mediation Board granted the ten-cent raise purely on "capacity to pay." It acknowledged that the hourly wages in the automotive industry are already higher than in other industries, but dragged in the thought that the seasonal nature of auto operations tends to reduce annual earnings. Obviously General Motors could not endure the onus of a strike over refusal to accept the Board's findings on the wage matter,—G.M.'s recent earnings position overshadows the fact that its wage structure already surpasses those of plants competing for labor in many of the communities in which G.M. plants are situated.

The UAW-CIO boasts of 700 contracts involving 550,000 workers and obviously it will try to win further wage increases wherever the prospects look bright. The effect upon auto production during the remainder of the 1941 model season is unpredictable, except that management may be disposed to grant concessions, in order to build the maximum number of cars before the Aug. 1 deadline upon which the curtailment program is figured. Certain major manufacturers plan now to continue peak capacity operations through May and June, and to schedule practically maximum capacity for July. Low priced volume producers like Chevrolet and Ford will probably operate for a few days into August.

Auto sales in early May were on a par with the similar period of April and there is a possibility of total May sales exceeding the record established in the previous thirty days. The sales leaders are experiencing no let-down in orders. One company reports its early May sales at one-third higher than production, its dealer stocks at 60 per cent of the level a year ago.

POOL U.S.-CANADA GOODS

WASHINGTON—The "materiel coordinating committee—U.S. and Canada" has been established to coordinate the productive capacity of the two countries. Vital information on their supplies of strategic raw materials will be exchanged. E. R. Stettinius, Jr., Director of Priorities, and Wm. L. Batt, Deputy Director of OPM's Production Division, are the American members.

PRODUCTION TOO SLOW

WASHINGTON — Calling for "a radical change of attitude" on the part of some people in government, labor and industry if the promises made to the defenders of democracy are to be made good, W. L. Batt, Deputy Director, Production Division, Office of Production Management, indicated that present U.S. production was not fast enough. "The only safe delivery date of defense equipment is yesterday," he said. Any part-time effort will fall short of the German full-time effort. Government, politics, strikes, living, and business "as usual" must be scrapped to defend the U.S.

Form New ASTE Chapter

DETROIT—The American Society of Tool Engineers has started a new chapter in Nashville, Tenn. with 42 charter members. The formation of this chapter, which is the 43rd in the society, is largely due to the rapid development recently of industry in the Nashville section in connection with defense.

Compulsory Subcontracting In U.S. Seen as Possibility

WASHINGTON — Compulsory subcontracting of defense contracts is an issue that is being hotly fought inside the defense organization. Subcontracting enthusiasts—mainly, but not entirely, New Dealers—are pushing for it hard, arguing that not more than half of available capacity is being used and that exhortation has proved unavailing. Immediate issue in the fight is whether the Defense Contract Service shall have the chance to look over all contracts before they are awarded.

But there is still strong opposition to compulsion. Army is cool to the whole idea, and Knudsen seriously dislikes compulsory measures. Meanwhile, advocates of compulsion recognize the difficulties that have led many manufacturers and procurement officers to shy away from the idea, but they insist that bringing in the small producer is essential to an all-out effort. Two methods of compulsion are being considered. One is to analyze contracts before they are awarded to determine how much of the work can be subcontracted; then it is planned to write into the contract a requirement that a certain part of the work be parcelled out. An even more promising approach, because it would reach contracts already awarded, is use of the priority system. By this plan a contractor asking a priority on new equipment would be told that if he would subcontract part of the work he would not need the equipment, and the priority would be refused.

WATCHING WASHINGTON

RFC earmarks $200,000,000 for machine tool pool to increase centralized buying; main purpose of pool, however, is to stimulate new capacity. Test Hillman's labor stabilization plan

By BLAINE STUBBLEFIELD

WASHINGTON—Increase in the centralized buying of machine tools through the so-called "machine tool pool" is indicated by announcement that RFC has earmarked $200,000,000 for this purpose. Previously only $35,000,000 was available for operations of the pool. It would be a mistake, however, to assume that the greater part of the machine tool output will be bought through Washington. Main purpose of the pool remains the stimulation of new capacity. When a machine tool manufacturer is asked to build a new plant, when a new subcontractor is developed, or in the occasional cases where a firm outside the industry is asked to go into the machine tool business, it is necessary to give assurance of orders for the product of the new facilities. Hence orders are placed for standard tools to go into the pool, without anyone knowing what their final destination will be.

Physically, of course, the pool is a collection of tools in process of manufacture. Long before they are finished, usually several months, they have been allocated to some particular use.

The way the pool operates is that OPM's Production Division decides, in consultation with Army and Navy officers, what orders shall be placed. The Army passes, in general, on tools for manufacture of light ordnance, planes, and tanks, while the Navy deals with tools for heavy guns and ships. The decision once made, RFC's Defense Plant Corp. places the order and holds title until a use is found for the tool. Then the manufacturer, who will use the tool, buys or occasionally leases it from DPC. Any defense prime contractor is eligible to buy from the pool, if the pool has the tool he wants.

The current big expansion in the operations of the pool arises of course from the greatly increased need for tools resulting from the accelerated schedules of armament production now being worked out. Whereas orders so far placed total about thirteen billion dollars, the whole program now envisioned will run to forty or fifty billions. Immediately in the cards, it is understood, is expansion of capacity for manufacturing heavy presses.

This device of using a pool of orders to insure continuity of work in new or existing production facilities may be applied in other industries besides machine tools. OPM is giving considerable thought to the possible use of this device, as well as other devices such as letters of intent in advance of contract, to enable manufacturers to schedule their work far into the future. The pooling device, of course, will only be effective where an industry is being asked to produce a few standard items which have relatively wide use.

Increase Bomber Program

First step in the new enlargement of the bomber program was issuance of letters of intent to Ford and to Boeing, Douglas, and Lockheed for the manufacture of four-engine bombers. Boeing and Lockheed were not included in the previous bomber program. Ford, as predicted in the last issue of AMERICAN MACHINIST, will build complete planes, of the Consolidated B-24 for which it has already contracted to manufacture parts.

Two new government assembly plants are to be operated by Boeing and Lockheed; what automotive firms will furnish parts to these plants is not yet known. Presumably Boeing will make its B-17, the original "flying fortress." Lockheed may assemble a new bomber of its own design, the B-49, which is still on the drafting board. This is reportedly a ship of about 40 tons, as compared with 20-25 tons for a flying fortress, and is designed to use the 2,300-2,500-hp. engines scheduled to be in production late next year. Douglas, presumably, will expand the mid-western bomber plant it is operating for the government in which it will assemble the Ford-built B-24. The contracts now in process of award are understood to involve a productive capacity of 150-200 heavy bombers a month.

Harris & Ewing

John Maynard Keynes, British economist, (above) is here to discuss financial phases of the lend-lease program with U. S. officials. He indicates that the U. S. will have to adopt some form of the "forced loan" now operating in Britain. Under this plan, a portion of each person's pay envelope is withheld and substituted by a promise to pay after the war. His economic theories are held in high regard by the New Deal

Test Regional Labor Agreements

The strike of machinists in the San Francisco shipyards puts to its first real test Sidney Hillman's scheme for regional labor stabilization agreements in the shipbuilding industry. The plan has already won a substantial victory in that the other metal trades unions considered it as sufficiently binding to justify going through the machinists' picket lines. The final test will be whether production will be resumed quickly.

In a technical sense, the machinists' strike is not a breakdown of the agreement. The stabilization agreement is not a collective bargaining contract. Strictly it is an agreement in principle on standard wage rates, hours, grievance machinery, and a no-strike-no-lockout clause, arrived at in a three-sided conference among representatives of government, labor, and employers. It is contemplated that these standard conditions will be incorporated into individual bargaining contracts. On the West Coast, this has already been done by nearly all the unions except the San Francisco machinists, either through formal contracts or verbal amendments to existing contracts. The situation of the Bethlehem yards is also somewhat unclear still.

Obvious difficulty in the plan is that although labor leaders take part in the conferences the results are not binding on the individual locals which do the contract signing. The machinist strike will test how serious this weakness is.

Immediate purpose of the regional agreement is to reduce migration of labor from one yard to another, but Hillman apparently sees his plan as a proper pattern for war-time collective bargaining in industry generally. It is unlikely, however, that any attempt will be made to expand the regional agreement system into other industries until shipbuilding agreements have been worked out on the lakes, the Atlantic, and the Gulf.

When this has been accomplished, the next step is the aircraft industry. It is here that the plan will have tougher sledding.

New Plant Expenditures Reach $1,915,000,000

WASHINGTON—The U. S. had committed itself to pay for $1,915,000,000 of new factory facilities in building the "Arsenal of Democracy" by March 31, 1941. The money is being used to build plants and machinery to manufacture airplanes, guns, tanks and other equipment. All commitments of the government, plus private financing under certificates of necessity total $2,892,000,000. When British commitments for plant facilities here are added, the total is $3,083,000,000. Of the government commitments, 86 per cent, or $1,412,000,000 is being spent on government-owned plants. The number of government financed plants as of March 31 was 331, at an average cost of $5,786,000, while the number of privately financed plants was 904, at an average cost of $729,000. The schedule calls for U. S. commitments to be greatly increased.

MORE ALUMINUM NEEDED

WASHINGTON — All available aluminum will be required for the armed forces of the U. S. in 1942, leaving none for civilian or "indirect" military requirements. At the peak of the armament program U. S. aircraft aluminum needs will be 900,000,000 pounds a year and other military requirements will total about 300,000,000 pounds. R. J. Reynolds, president, Reynolds Metal Co., indicates that the construction of U. S. aluminum plants to bring production above 1,500,000,000 pounds annually is essential to defeat Axis powers. The government's present expansion program of 600,000,000 pounds annually includes importation of 200,000,000 pounds annually from Canada. Defense officials are talking of 2,000,000,000 pounds annually.

Electric Truck Bookings Continue at High Level

CHICAGO—April bookings of electric industrial trucks and tractors, both in unit and dollar value, continued at a high level, although somewhat lower than the peak established in February, it was indicated in a report by the Industrial Truck Statistical Association, 208 South La Salle St., Chicago, Ill. April bookings totaled 430 units as compared with 436 units in March. During the first four months of 1941 units booked totaled 1,605 as compared with 392 during the same period in 1940, an increase of 309 per cent. Total net value of chasses only was $1,472,225 during April compared with $1,557,591 during March.

U. S. Government Contracts Awarded to Metal-Working Firms

(Does not include contracts under $100,000)

Source	Agency	Commodity	Amount
Johnson & Johnson, Chicago, Ill.	War	Carriers	$400,090
Luders Marine Construction Co., Stamford, Conn.	Navy	Hull and fittings	280,000
Stewart-Warner Corp., Chicago, Ill.	War	Fuse parts	498,671
Schwitzer-Cummins Co., Indianapolis, Ind.	"	Cartridge cases	2,255,861
Aluminum Co. of America, Washington, D. C.	Navy	Aluminum alloy	1,092,360
Westclox, Div. of General Time Instruments Corp., La Salle, Ill.	War	Fuse parts	101,465
Machinery Builders, Inc., Long Island City, N. Y.	Navy	Ammunition hoists	239,488
American Monorail Co., Cleveland, Ohio	War	Cranes	313,182
National Malleable & Steel Castings Co., Cleveland, Ohio	"	Shell and fin assembly	2,283,040
C. H. Wheeler Mfg. Co., Philadelphia, Pa.	Navy	Airplane machinery	366,150
Carlton Machine Tool Co., Cincinnati, Ohio	"	Radial drilling machines	570,410
Bauer Brothers Co., Springfield, Ohio	War	Machining shell	2,337,740
Cleveland Twist Drill Co., Cleveland, Ohio	"	Drills	257,136
International Harvester Co., Washington, D. C.	Navy	Trucks	769,886
Eclipse Aviation Div., Bendix Aviation Corp., Bendix, N. J.	"	Hand & electric starters	1,193,167
International Harvester Co., Fort Wayne, Ind.	"	Motor trucks	159,600
Defoe Boat & Motor Works, Bay City, Mich.	"	Sub. chasers	4,960,800
Ford Motor Co., Dearborn, Mich.	War	Airframes	3,418,500
Gen. Motors Corp., Delco Prod. Div., Dayton, Ohio.	"	Landing gear	992,389
Cramp Shipbuilding Co., Philadelphia, Pa.	Navy	Floating workshops	960,000
Gen. Motors Corp., (Chev. Div.) Detroit, Mich.	"	Motor trucks	164,447
J. K. Welding Co., Inc., Brooklyn, N. Y.	"	Floating workshops	491,000
Standard Steel Works, N. Kansas City, Mo.	War	Trailers; dollies	624,332
Sperry Gyroscope Co., Inc., Brooklyn, N. Y.	"	Directors	869,558
Sperry Gyroscope Co., Inc., Brooklyn, N. Y.	Navy	Gyro compasses	1,616,850
Sperry Gyroscope Co., Inc., Brooklyn, N. Y.	War	Automatic pilots	116,000
Chapman Valve Mfg. Co., Indian Orchard, Mass.	Navy	Valves	107,159
Walworth Co., New York, N. Y.	"	Tube fittings	1,500,000
Midvale Co., Washington, D. C.	"	Steel forgings	330,408
American Rolling Mill Co., Butler, Pa.	"	Valves	658,369
Nicholson File Co., Providence, R. I.	"	Files; rasps	150,404
National Cash Register Co., Dayton, Ohio.	"	Fuses	1,490,760
Universal-Cyclops Steel Corp., Bridgeville, Pa.	War	Steel rods	400,184
Pittsburgh Steel Co., Allenport, Pa.	Navy	Steel tubing	126,656
Pittsburgh Valve & Fittings Corp., Barberton, Ohio.	"	Bronze valves	106,257
Allis-Chalmers Mfg. Co., West Allis, Wis.	"	Shafts and couplings	537,280
Revere Copper & Brass, Inc., Rome, N. Y.	"	Brass	109,317
Caswell Strauss & Co., Inc., New York, N. Y.	"	Pig tin	291,200
Chase Brass & Copper Co., Inc., Waterbury, Conn.	"	Tubing	346,893
Revere Copper & Brass, Inc., Rome, N. Y.	"	Condenser tubes	148,519
Cincinnati Bickford Tool Co., Cincinnati, Ohio.	"	Drilling machines	778,342
Hardie Tynes Mfg. Co., Birmingham, Ala.	"	Air compressors	220,120
Ingersoll-Rand Co., Phillipsburg, N. J.	"	Air compressors	390,380
General Electric Co., Erie, Pa.	War	Diesel electric locomotives	197,400
John Wood Mfg. Co., Inc., Muskegon, Mich.	"	Machine gun equip	655,803
Chicago Pneumatic Tool Co., Detroit, Mich.	"	Riveters	107,220
International Harvester Co., Washington, D. C.	Navy	Tractors	141,139
Vickers Inc., Waterbury Tool Div., Waterbury, Conn.	"	Motors and pumps	686,634
Mack Mfg. Corp., Long Island City, N. Y.	War	Tank drive assy	9,907,427
Willys-Overland Motors, Inc., Toledo, Ohio.	Navy	Machine gun mechanisms	1,939,000
Worthington Pump & Mach. Corp., Buffalo, N. Y.	"	Air compressors	326,291
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.	"	Elec. welding sets	108,260
General Cable Corp., Rome, N. Y.	War	Wire and reels	659,890
Western Elec. Co., Point Breeze, Md.	"	" "	515,540
Phelps Dodge Copper Products Corp., Yonkers, N. Y.	"	" "	342,975
Anaconda Wire & Cable Co., New York, N. Y.	"	Wire	532,000
General Electric Co., Schenectady, N. Y.	Navy	Equipment	171,345
Towmotor Co., Cleveland, Ohio.	War	Fork lift trucks	120,960
Clark Tructractor, Div. of Clark Equip. Co., Battle Creek, Mich.	"	Utilities	120,960
Eugene Dietzgen Co., Chicago, Ill.	"	Compasses and dividers	105,125

NAMES in the NEWS

James E. Bevan has been named vice-president in charge of manufacturing, and W. R. Swoish has been named vice-president in charge of sales, Roller-Smith Co., Bethlehem, Pa.

Arno L. Billeter has been appointed assistant to general superintendent in charge of manufacturing practice, and Thomas W. Hunter has been named superintendent of the flat products finishing division at Irvin Works, Pittsburgh, Carnegie-Illinois Steel Corp. George H. Dowding has been named superintendent, and Elmer A. Johnson has been named assistant superintendent of Industrial Relations at the company's South Works, Chicago. G. S. Mican has been appointed assistant division superintendent of rolling and D. F. Farnsworth has been named superintendent of a group of blooming and structural mills also at South Works. Charles T. Siebert, Jr., formerly assistant treasurer, has been named assistant to the vice-president in charge of sales, and George A. Whitehurst, for the last five years a Chicago district industrial engineer, has been promoted to assistant to chief engineer, Carnegie-Illinois Steel Corp., a subsidiary of U. S. Steel Corp.

John H. Collier, formerly vice-president in charge of manufacturing, has been elected president, Crane Co., Chicago. Mr. Collier, who has been with the company since 1903 when he began work as a core maker's helper, had been elected vice-president in 1933.

C. R. Cox has been elected executive vice-president, The National Tube Co., a subsidiary of the U. S. Steel Corp., succeeding B. C. Moise who has retired after more than fifty years' continuous service. Elmer N. Sanders, formerly assistant vice-president in charge of operations, has been elected

Heads Crane Co.

JOHN H. COLLIER

Allis-Chalmers V-P

LEE H. HILL

Bantam Bearings V-P

R. B. NICHOLS

Harvester Chairman

SYDNEY G. McALLISTER

vice-president in charge of operations, succeeding Mr. Cox who previously held that position.

Don T. Flater, formerly works manager of the Chrysler-Jefferson plant, has been appointed general staff master mechanic, Chrysler Corp. He succeeds F. J. Morisette who has just been placed in charge of the Chrysler Gun Arsenal.

L. J. Fletcher has been appointed director of Training and Public Relations, Caterpillar Tractor Co., Peoria, Ill.

Stewart S. Hathaway, a director for the past 21 years, has been named chairman of the board, the Buda Co., Harvey, Ill.

Lawrence W. Howe has been named vice-president and general manager, Lincoln Park Tool & Gage Co., Lincoln Park, Mich. He succeeds George Eglinton who resigned.

Glen T. Lampton has been named assistant engineer in charge of experimental engineering, Hamilton Standard Propeller Div., United Aircraft Corp., Hartford, Conn. Formerly, Mr. Lampton was engineering manager, Lycoming Div., Aviation Manufacturing Corp.

R. J. Lindquist, chief auditor, Reconstruction Finance Corp. since 1932, has been elected vice-president and a director of the Reynolds Metals Co., Richmond, Va.

Lee H. Hill, who has been elected vice-president, Allis-Chalmers Mfg. Co., Milwaukee, will head up a newly created industrial relations department. W. C. Van Cleaf will continue his work in this department reporting to Mr. Hill. Mr. Van Cleaf has been with the company for 30 years. Fred W. Bush and W. C. Sealey have just been named engineer in charge of transformer sales and engineer in charge of transformer design, respectively. Ervin Manske has been appointed general traffic manager of the company's eight plants.

Sydney G. McAllister has been named chairman of the executive committee and Fowler McCormick has been elected president, International Harvester Co., Chicago, Ill. Fowler McCormick, who had been second vice-president, joined the company in 1925 as an employee in the Milwaukee factory. Carl O. Schreiber, who has been assistant to the vice-president in charge of manufacturing, has been named vice-president with supervision over manufacturing, industrial relations, and industrial engineering and construction. Arnold B. Keller, treasurer since 1932, has also been elected vice-president.

R. B. Nichols has been named vice-president and general manager, and J. Frank Oehlhoffen has been named sales manager, Bantam Bearings Corp., South Bend, Ind.

E. D. Spicer, formerly manager of the Schenectady works, General Electric Co., has been named assistant to the vice-president in charge of manufacturing. J. M. Howell, formerly assistant to Mr. Spicer, will succeed him as manager.

Hugo Stokvis has been named chairman of the board, R. S. Stokvis & Son, Inc., Willemstad, Dutch West Indies. Theo Stokvis and J. H. H. Verloop have been named directors, while Edward Stokvis has been named manager.

R. W. Turnbull has been elected executive vice-president, Edison General Electric Appliance Co., while I. A. Rose has been named vice-president in charge of manufacturing and J. C. Sharp has been named vice-president in charge of engineering.

PLANT EXPANSION

Blaw-Knox Steel Co., Pittsburgh, has purchased the old Laughlin plant of Carnegie-Illinois Steel Co. The plant, which was closed about a year ago, will be put into operation on defense orders.

Earnshaw Motors, Inc., Oildale, Calif., is equipping a new engine factory for the production of two-cylinder air-cooled engines for use in motor boats.

Elastic Stop Nut Corp., Union, N. J., has doubled the floor space of its plant.

The Ford Motor Co. of Canada, Ltd., will expand its plant and manufacturing facilities at a cost of $1,500,000.

The International Derrick & Equipment Co., Torrance, Calif., has completed its new galvanizing plant designed for the galvanizing, pickling and painting of ship plates.

Latisteel Corp. of California, Pasadena, is erecting a new fabricating plant.

Revere Copper & Brass, Inc., will build in Chicago a new brass sheet rolling mill at a cost of approximately $10,000,000. Construction is expected to begin within four weeks and the plant is scheduled to be completed in about four and one-half months. The plant, to be built by government funds, will have a maximum capacity of 15,000,000 lb. of sheet brass per month.

The Triplex Screw Co., Cleveland, Ohio, has completed a new plant which is 80 x 100 ft.

New Appointments Made in Olds Motor Works as the Concern's Defense Work Increases

H. J. CUPPER

J. H. ALFES

K. C. PLASTERER

J. G. HICKMAN

CHANGE OLDS PERSONNEL

DETROIT—To expedite preparations for the manufacture of machine guns for the U. S. Army the Olds Motor Works here has thoroughly reorganized its management personnel. S. E. Skinner, general manager of the Olds defense program, both shell and machine gun manufacture, announces that R. E. Griffin has been appointed production manager in charge of shell and machine gun manufacture, Olds Motor Works, Detroit. H. J. Cupper, former Detroit Oldsmobile zone manager, has been named assistant to Mr. Griffin; K. C. Plasterer, formerly plant manager, General Motors Forge plant, has been named manufacturing manager of defense plants, while J. G. Hickman, formerly engineer, Olds Motor Works, has been appointed standards engineer; C. B. Dakin, formerly assistant plant manager of the Forge Plant, has been named plant manager; and J. H. Alfes, former chief inspector, Olds Motor Works, has been appointed plant manager of the gun division. The Olds Motor Works has just received a government order amounting to approximately $13,000,000. The gun division is being set up in existing facilities and a large part of the $2,750,000 worth of machine tools required has been allocated.

BUSINESS ITEMS

Aero-Alloys Co. has been organized at Los Angeles, by Walter J. Cunningham.

American Tool Products Co., Los Angeles, is the firm name under which W. E. Miller and William J. Mead have obtained a certificate to conduct business.

Blue Wibard Tool Co., Los Angeles, has been incorporated by N. N. Hasceltine.

Consolidated Tool & Die Corp., Michigan City, Ind., has been formed to manufacture tools and dies.

Engine Parts Co., Los Angeles, has been incorporated by Philip E. Hungerford.

General Aircraft Instrument Service, Los Angeles, has been formed by L. Marvin Say.

The H P L Manufacturing Co., Cleveland, Ohio, has recently been established by Ray Hedberg, K. Peterson and Melvin Lorentz. The new concern will specialize in stampings in small quantities.

Karl Johnson Corp., Kokomo. Ind., has just been incorporated and will manufacture tools and machinery.

The Maxim Silencer Co., Hartford, Conn., has opened a sales office at 228 N. LaSalle St., Chicago, Ill.

Morrison Machine Products Div., Hardinge Bros., Inc., Elmira, N. Y., will be discontinued and all business will be carried under the name of Hardinge Bros., Inc.

OBITUARIES

Victor Lee Emerson, a mechanical and chemical engineer who was known widely as "The Philadelphia Edison" because of the number and importance of his inventions, died recently. Mr. Emerson held patents covering nearly 100 inventions, many of which helped develop the automobile. He was credited with making available the bevel gear drive, the unit power plant, the cantilever spring, force feed lubrication, and the universal joint.

Charles F. Froideveaux, 74, head of the machine department, Collins Co., Collinsville, Conn., died recently.

Oscar Caperton Huffman, president, the Continental Can Co., and a member of the War Industries Board during the World War, died recently after a short illness. In 1903 he organized and headed the Virginia Can Co., later moving to Cincinnati to establish the United States Can Co., which merged with the Continental Can Co. in 1928. In that year Mr. Huffman was made vice-president of the merged company, becoming president a year later.

J. Watson Owings, 56, metallurgist, the Meehanite Metal Corp., Pittsburgh, died recently in Spokane, Wash. He had been associated with the company since 1936.

John G. Rumney, 90, chairman of the board, Detroit Steel Products Co., which he founded in 1904, and president of the Fenestra Construction Co., died recently. His son, Mason D. Rumney, is vice-president, Detroit Steel Products Co.

Raymond A. Young, 40, president, Young Sales, Inc., Milwaukee, Welding Supply Firm, died April 22 in Milwaukee after a short illness. In 1937 he organized the firm of which he was president.

MEETINGS

American Society of Mechanical Engineers. Semi-annual meeting. Kansas City, Mo., June 16-20.

American Society for Testing Materials. Annual meeting to be held in conjunction with an exhibit of testing apparatus at the Palmer House, Chicago, Ill., June 23-27.

Society of Automotive Engineers. Summer meeting. The Greenbrier, White Sulphur Springs, W. Va. June 1-6.

SHOP EQUIPMENT NEWS

Jones & Lamson Internal Thread Grinding Machines Feature Fully Automatic Operation

Fully automatic operation is a feature of the line of internal thread grinding machines developed by Jones & Lamson Machine Co., Springfield, Vt. These machines are now available in three models, as follows:

Model TG-63 swings 7½ in. It grinds threads up to 6 in. in diameter and 3 in. maximum length, in work up to 10 in. overall length. A separate leadscrew and nut for each different pitch is required. This model is a light, fast machine for work within its capacity.

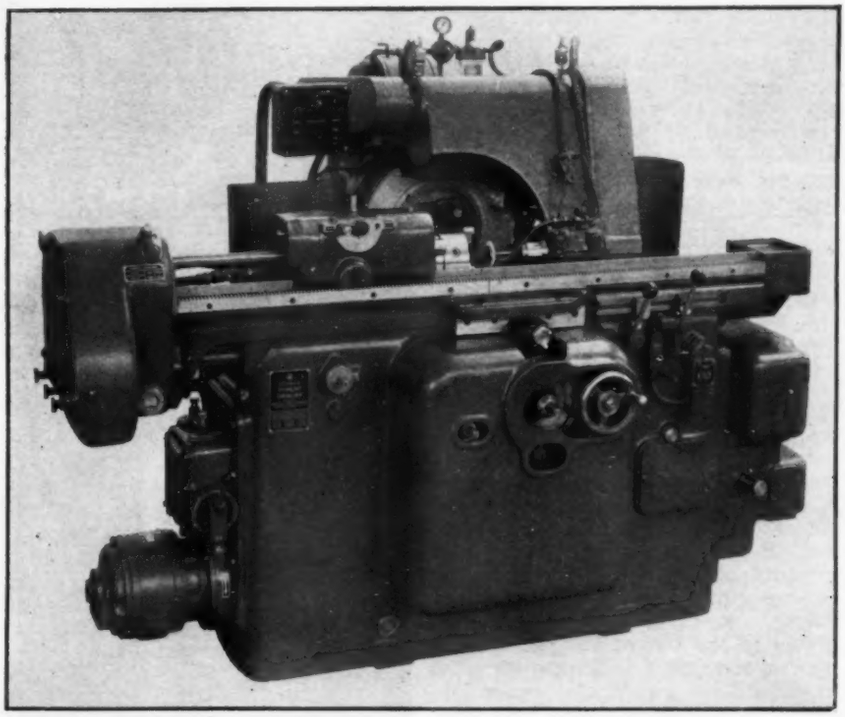
Model TG-624 swings 7½ in. This machine grinds threads up to 6½ in. in diameter and 5 in. maximum length, in work up to 24 in. length over-all. This model is completely universal and is capable of handling toolroom or production work of any size or weight within its rated capacity.

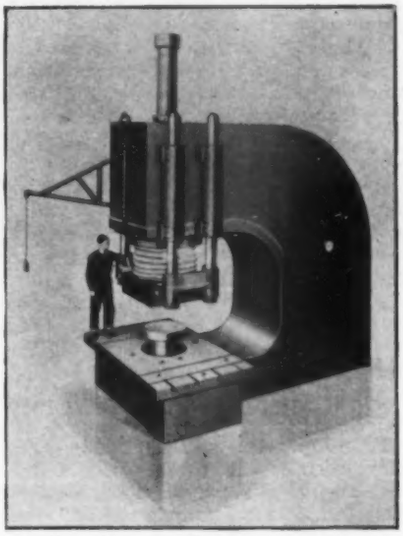
Model TG-1230 swings 21 in. This machine grinds threads up to 14 in. in diameter and 5 in. maximum length, in work up to 24 in. maximum length. This machine is completely universal and is also capable of handling toolroom or production work of any size or weight within its rated capacity.

For the latter two models, a hardened and ground master leadscrew and pitch change gears are furnished as standard equipment for grinding any pitch thread from 2 to 48 inclusive, eight right or left hand, and either single, double, triple, quadruple or sextuple lead.

On all models the grinding wheel spindle is automatically withdrawn from the grinding position to the wheel dressing position, the wheel is dressed automatically, and the grinding wheel spindle is returned to the working position. The amount dressed off the wheel is compensated for automatically. The machine feeds in automatically on successive cuts until size is reached, when the wheel spindle automatically moves to the dressing position and the machine stops. Each model is provided with a d.c. wheel motor with rheostat control to permit a complete range of grinding wheel speeds.

Ample clearance is provided for gaging and changing work. With the machine in gaging position a safety device locks the position of the grinding wheel spindle to prevent accident to the operator while gaging or changing the work.





Denison C-Frame Press Exerts 400-Ton Pressure

A 400-ton, C-frame hydraulic press that combines the main ram, rapid traverse cylinder, and a stripper cylinder operating through the bolster, has been completed by Denison Engineering Co., 119 W. Chestnut St., Columbus, Ohio. The oil reservoir, the hydraulic pump and motor, the motor starter, electrical controls and the control valves are all assembled within the open or C-type frame. The frame is constructed entirely of welded steel plate thoroughly annealed and normalized. To obtain the proper working height for the bolster, the press extends below the floor level.

The main press cylinder has a capacity of 400 tons, a 30-in. stroke. It is single acting, and has a 36 x 36-in. platen provided with T-slots. Two guide rams, operating in bronze-lined bearings, are attached on each side of the press frame to prevent the main ram from rotating. The rapid traverse, or pull-back, cylinder is double-acting, and is flange mounted on the main press cylinder. It has the same stroke and working pressure as the main cylinder. It has a down-speed of 6 ft. per min., and an up-speed of 10 ft. per min. The hydraulic stripper cylinder is double-acting, and is flange mounted to the sub-bolster in the lower part of the press frame. An easily removable packing gland at the top of the stripper cylinder fits flush with the bolster so as not to interfere with work on the bolster. The upper end of the stripper cylinder ram is machined to permit easy attachment of bending tools or dies. The stripper

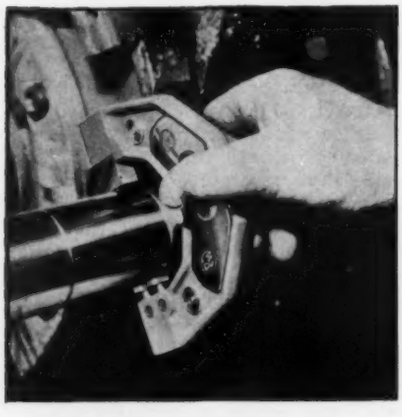
ram is protected by a steel cover when not in use. The bolster is machined to accommodate the stripper cylinder and is machine finished all over. It is provided with T-slots for affixing tools. Horizontal surface of the bolster is 60 x 96 in.

A pendant-type control station on a swinging bracket extending from the front of the press has pushbutton control for the main ram, for rapid traverse speed down, for slow speed down, and for reversing the ram. The stripper cylinder is operated from either of two pushbutton stations, placed on opposite sides of the press frame. All cylinder and ram operations and their controls are coordinated and provided with safety arrangements to give full protection against damage, either to the press or to the work.

Adjustable Limit Snap Gages Offered by Pratt & Whitney

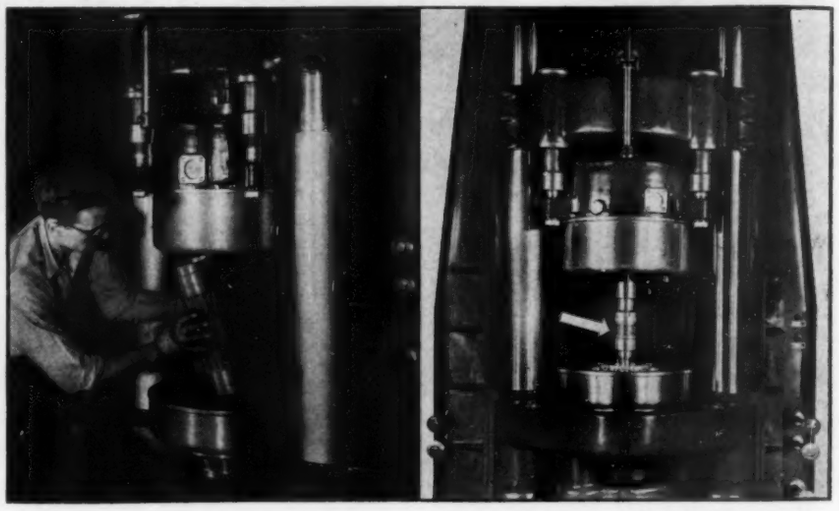
"Trusform" adjustable limit snap gages have been developed by Pratt & Whitney Div., Niles-Bement-Pond Co., West Hartford, Conn., to provide an ideal gage for the limit system which permits inspecting the work in one hand operation.

Bakelite grips are supplied with "Trusform" Model C gages to insulate them from the heat of the operator's hand. These grips are molded to conform to the fingers, and aid in retaining a comfortable, positive grip on the tool. The solid anvil projects beyond the end of the frame and the adjustable anvils. This permits the gage to locate itself quickly on the work. The anvil is made flush with the side of the frame, permitting the operator to check close to a shoulder.



The adjustable anvils have a rectangular head providing a broad wearing surface. Made of high grade tool steel, heat treated and lapped flat and square with the shank, these two anvils are interchangeable with each other. Adjustable anvils are easily set and locked to gage blocks or master disks.

Internal Bore Surfaces Hardened Electrically By Budd Induction Heat-Treating Process

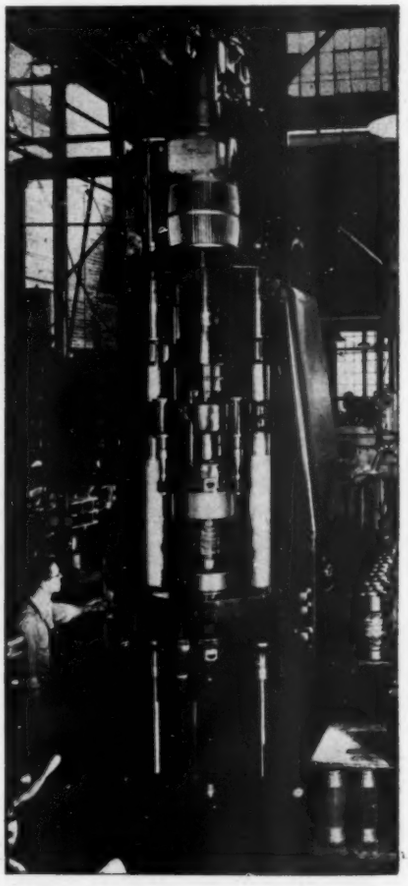


A diesel cylinder sleeve is placed in the Budd induction heat-treating machine, left, for hardening. Right, the heat head and quenching device in operating position. The cylinder liner is held in place by chucks, one of which is just below the head, while the head is drawn steadily through the bore. Entire hardening cycle takes only a few seconds

Longer life and greatly improved physical properties are but two of the advantages claimed for a process of hardening internal bore surfaces developed by Budd Induction Heating, Inc., a subsidiary of Budd Wheel Co., Detroit, Mich. With this process such parts as cylinder liners and wheel hubs can be heat-treated under precise control, achieving an extremely hard surface while the remainder of the part retains its original toughness. Other advantages include high-speed operation and the possibility of simplified product design.

Differential hardening by electromagnetic induction is accomplished through the concentration of high-power, high-frequency currents in the surface zone to be hardened. As applied in the Budd method of hardening inside surfaces of cylindrical objects, the currents are made to flow almost entirely in the shallow internal surface zone. Temperature of this zone is raised to hardening temperature before any substantial amount of heat can be transmitted to the rest of the piece. This thermal energy is then trapped through immediate application of a controlled water quench. An extremely hard surface is thus obtained, while the remainder of the cylinder, due to the speed of the operation, has remained relatively cool and therefore has not been affected. Accurate control of power input, current time and water quench yield precise control over the affected metal.

The first successful application of the process was to the bores of automobile hubs, in which a section of the inside diameter is hardened to form a roller



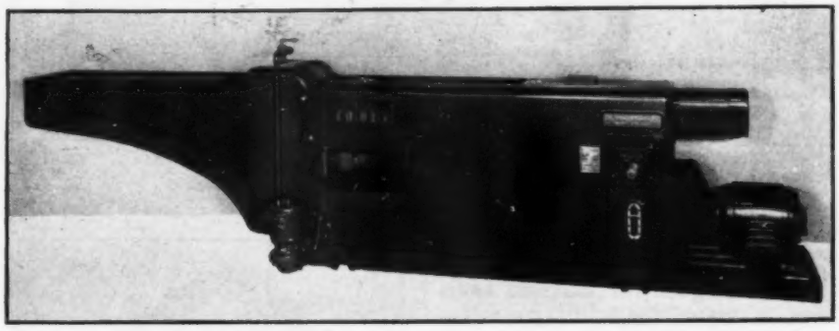
Inside diameters of tractor engine cylinder liners are hardened automatically in this Budd induction heat-treating machine

bearing race. The process is also being used by Caterpillar Tractor Co. in heat-treating internal combustion engine cylinder liners. In this latter application, the machine hardens the inside diameters of cast iron liners to 52-55 Rockwell C, which are subsequently tempered to a slightly lower value. Depth of hardness is about 0.070 in. Liners from 10 to 15 in. long, with bores of 3¾ to 5¾ in., are treated and then honed to a mirror finish.

Heart of the machine which performs the operation is an induction heat head which is drawn through the bore, or over which the part is pulled. Movement of the head, application of the current, and operation of the quench are entirely automatic. The machine is designed for rapid change-over from one bore size to another. It is compact enough to be placed directly in the production line. Only one operator is required.

Colonial Universal Horizontal Broaching Machines Improved for Greater Capacity and Wider Ranges

Numerous improvements are included in a complete new standard line of universal horizontal broaching machines introduced by Colonial Broach Co., 147 Jos. Campau St., Detroit, Mich. The standard machines range in capacity from 3 tons and 36-in. stroke to 25 tons and 90-in. stroke, with larger capacities also available on special order. In these machines peak capacities have been substantially increased over the normal ratings, to provide greater reserve power and smoother operation when tooling is adapted for the normal capacities of the machines.



Features include a shockproof control mechanism to prevent impact of the starting lever at each end of the stroke and a readily accessible and increased vertical adjustment for the drive head to provide greater flexibility for off-center special broaching set-ups. Provision for convenient mounting of spiral broach drive heads has been maintained, adapting the machine to spiral broaching set-ups.

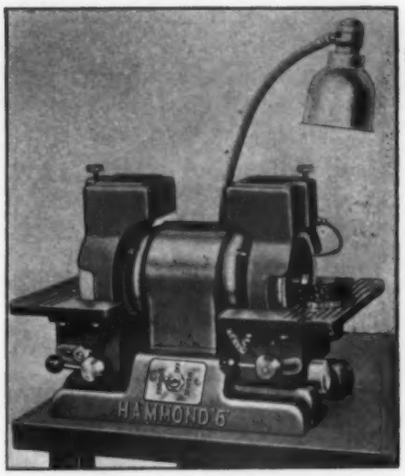
Construction improvements are numerous. Cylinders are of steel tube construction with welded joints to insure against leaks and to provide longer life. Valves and piping have been simplified to facilitate accessibility for service and maintenance. An integral motor and pump bracket assures correct alignment between these units, preventing wear and giving longer life with quiet operation. A rigidly constructed chip pan is provided, which can be used for a broach follow-rest support when required. The chip compartment is readily accessible for chip removal. Due to simplified piping, additional reserve space is available within the machine for storage of tools, pullers, adapters, etc.

The main frame is of welded steel construction using steel castings wherever necessary to strengthen points where excessive strain is applied, such as face plate, cylinder mounting, etc., and so designed that it completely incloses the operating mechanism. The machine face is of sufficient area to support and attach surface broach fixtures, and provided with an extremely large hole to permit maximum broach capacity. The face has two keyways placed centrally with the hole and 90 deg. to each other, affording a positive and accurate locating position for fixtures. The crosshead has replaceable hard bronze shoes which ride on hardened and ground ways, provided with means of lubrication to insure long life. Both crosshead and pullhead have identification marks to indicate when pullers are adjusted centrally with keyways on the face of the machine.

6-In. Carbide Tool Grinder Built by Hammond Machinery

A carbide tool grinder using 6-in. silicon carbide or diamond wheels has been placed on the market by Hammond Machinery Builders, Inc., 1618 Douglas Ave., Kalamazoo, Mich. This machine, first in a series of three soon to be completed, stresses heavier, machine-tool construction for additional strength and solidarity demanded by production schedules.

Extra-heavy tilting tables are easily removable. No tools are required. To install new wheels, a single clamp releases the table which may be quickly slid off the supporting shaft. Tables are slotted for the protractor angle-guide furnished with machine. Inside edge of each table is machined inward at an angle to permit tilting without necessitating readjustment of the distance between table and wheel. The cast-iron support under each table serves also as a sludge pan and is easily removed and cleaned by releasing the same clamp that locks the tilting table to the supporting shaft. For accuracy in grinding angles, a plainly marked indicator, ranging from 0 to 25 deg., is mounted directly beneath each table. Tables tilt to exact angle of adjustment easily, sliding on machined quadrants. Motor is heavy-duty type, ½ hp., 3450 r.p.m., with over-size precision ball bearings.

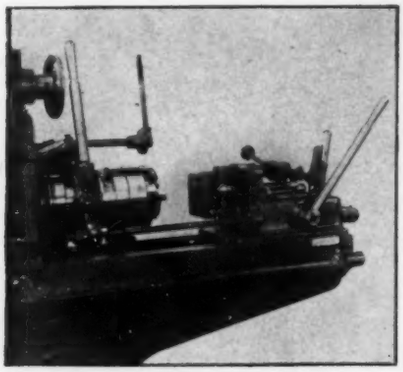


Motor is reversible for right or left hand grinding, controlled by switch at front of machine. Brake is built-in. For wet grinding, an integral wheel guard and coolant tank, as illustrated, may be substituted easily for the standard cast-iron wheel guard. Coolant is carried to the wheel by a copper tube. Needle valves, atop each tank, control the flow.

Landis Holding Device Helps Thread Shell Caps

A fixture developed by Landis Machine Co., Waynesboro, Pa., provides a means for holding 37-mm. shell caps rigidly in alignment for threading. This device comprises a hardened and ground supporting bushing, a supporting center and a supporting center locking member.

In operation, the shell cap is placed on the supporting center while in the position shown in the illustration. The center is then moved forward until the work enters and seats in the supporting bushing. The work is then locked into position for threading with the supporting center locking lever. The entire unit is adjustable both hori-

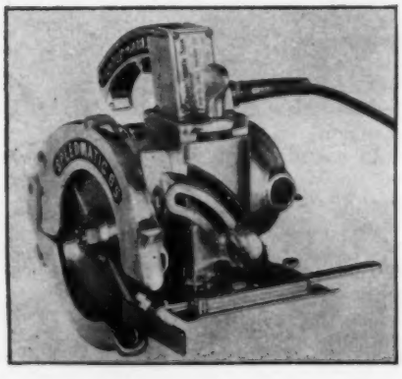


zontally and vertically to assure accurate alignment of the work with the center of rotation of the threading die head, thus assuring the production of concentric threads.

This work holding fixture is designed for use on the Landis ¾ and ⅞-in. single or double head threading machines. The shape of the parts will not permit gripping on the outside surface and makes it necessary to employ this socket type fixture and an internally tripped die head. Any slight variation in size would change the location of the work in the fixture. Thus, the internally tripped die head prevents any possibility of the chasers striking the shoulder of the work and also assures threads of uniform length.

Porter-Cable "Speedmatic" Saw Features High Performance

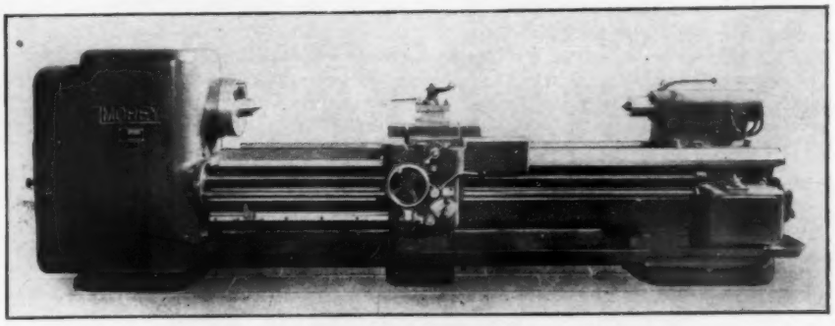
Exceptionally high performance, combined with light weight, is said to be an outstanding feature of the Type K-65 "Speedmatic" portable electric saw offered by Porter-Cable Machine Co., Syracuse, N. Y. This machine carries a 6½-in. diameter blade, with a cutting capacity of 2-in. material, yet weighs only 15½ lb. The blade travels at 7200 r.p.m. and is driven by helical gears. The tool is powered with a ⅝-hp. universal motor. The base raises and lowers for depth of adjustment and tilts to 45 deg. for bevels. The frame is of die cast aluminum. Standard equipment includes combination saw blade, ripping guide, cross-cutting guide, and metal carrying case.



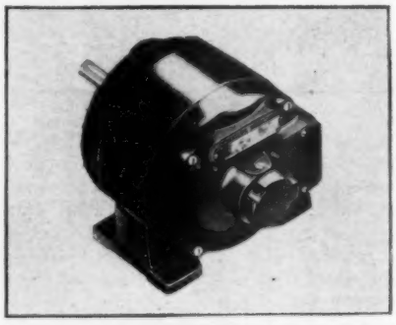
Morey 27-In. Manufacturing Lathe is Suitable For Heavy-Duty Single-Purpose Turning

Built for heavy-duty work on single-purpose operations and designed for efficient handling by non-skilled labor, the 27-in. manufacturing lathe offered by Morey Machinery Co., 410 Broome St., New York, N. Y., has been constructed with a view toward efficient operation in connection with the defense program. Built throughout for turning at the maximum speeds and feeds possible with tungsten carbide tools, this machine has a swing over ways of 28 in., swing over carriage slide of 11 in., distance from end of spindle to tailstock center (12-ft. bed) 48 in., and a weight of approximately 12,800 lb. The machine can be provided with either a 25- or 50-hp. motor.

Features include: Finger tip control, speeds which can be set to suit each individual job, spindle speed variation by pick-off gears, instant speed selection, hydraulic feeds, automatic stops, power traverse, ease of handling, and anti-friction bearings throughout. All gears in the head are of chrome nickel steel, heat-treated. Final drive is through herringbone gears.



G.E. Fractional-Horsepower Motor Designed For Machine Tools



A fractional-horsepower motor, built specifically to meet the requirements of machine tools and other industrial applications where frequent start-stop service, plugging, and metal-dust atmospheres are encountered, has been introduced by General Electric Co., Schenectady, N. Y. It is available in ¼, 1/3, ½, and ¾ hp. sizes for operation on three-phase and d.c. systems.

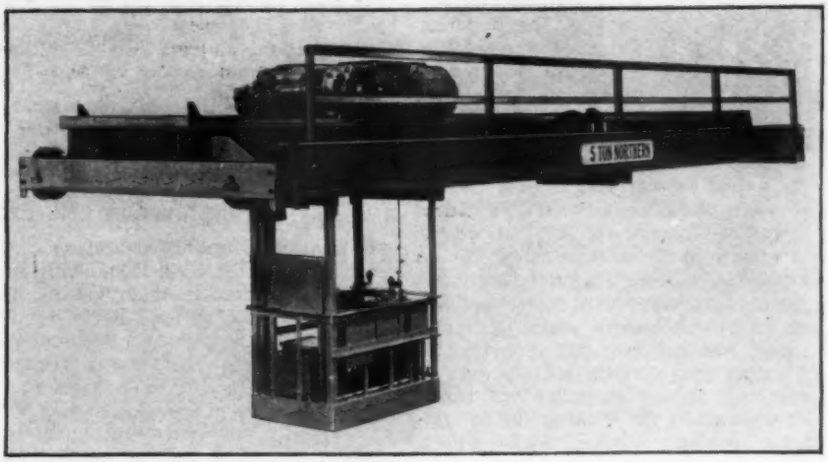
Fashioned to the specifications of machine tool builders and industrial users as a result of extensive investigation, the motor is of totally inclosed construction. It has several design features to provide it with the high degree of rigidity and sturdiness demanded in machine tool operation. Its outstanding features include a sturdy cast-iron base, closely machined end-shield and stator rabbets, tough "Formex" insulation, ball bearings, one-piece indestructible cast-aluminum rotor, and firmly anchored windings.

The motor's totally inclosed construction protects it against abrasive metal dust, chips, cutting compounds, and other foreign materials. A convenient conduit box built into the end-shield contributes to compactness and pleasing appearance in harmony with modern tool design.

The stator is especially designed to withstand the stresses of starts and stops as well as plugging and momentary overloads. Both stator and end-shield rabbets are machined to close tolerances, providing concentricity between the rotor and the stator, so that a uniform air gap is maintained.

Because of the trust encountered on the majority of machine tool applications, ball-bearing assemblies are used. This type of bearing construction allows mounting the motors with the shaft at any angle to the horizontal, and the stator can be rotated to any desired position. End-mounted motors can be mounted vertically as well as horizontally and may be obtained for flange, flat-face, or rabbet-machine mounting.

As protection against the vibrations encountered in machine tool, as well as other applications, base-mounted motors are furnished with a malleable, cast-iron base bolted to the stator. Mounting dimensions of this base are similar to those for motors of comparable frame size which have been furnished previously for machine tool service.



Line of Lighter Cranes Made by Northern Engineering

Northern Engineering Works, Detroit, Mich., has introduced Types S. A. and L.S.A. cranes to supplement its line of "Super-Cranes." These cranes embody many of the features of the heavier line, but provide a more economical installation where service is not extreme and continuous.

Some of the features of this new line are: One piece, all steel welded trolley frame construction; horizontally split hoist gear housing; heat-treated, hardened, rolled steel, machine cut gearing; splash lubricated hoist gearing and bearings; removable, safety type mechanical load brake; standard foot-mounted ball-bearing motors, and special heavy wide flange triple girder bridge construction. Throughout the construction, welding is used extensively to provide a rigid structure and maximum strength.

Baush Radial Arm Machine Does Drilling and Tapping

Baush Machine Tool Co., Springfield, Mass., has developed this combination radial arm drilling and tapping machine to carry out both drilling and tapping operations with minimum time and effort required for changeover. It is intended for all classes of single-spindle work where ease of head manipulation for targeting and accuracy of work produced are essential. Conversion from one operation to the other is accomplished by a simple clutch arrangement built into the head.

The carriage through which the arm travels is ball-bearing mounted for ease of operation. Construction is such that the arm rides on eight ball bearings, four at the bottom and four above. All bearings are angularly mounted on eccentric bushings for adjustment. Construction assures accurate alignment.

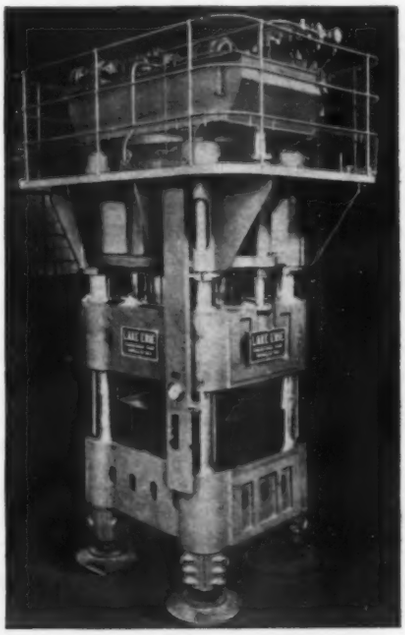
The head mounted at the forward end of the arm houses the spindle quill and the electrical control mechanism for tapping. The quill accommodates either a drilling or tapping spindle. The spindle may be detached from the quill simply by pressing a latch and allowing the spindle assembly to drop out. When drilling, the quill is used as a feeding mechanism operated by a spider handwheel. When tapping, the quill is used to adjust the position of the top over different levels of the holes, eliminating the necessity of moving the knee table or part. The quill has a maximum vertical adjustment of 4 in.

The control mechanism consists of a motor starter pushbutton, an adjustable automatic electric counting switch for setting the tapping depth, a clutch from the motor drive to the electric counting switch, and a motor control converter. A ¾-hp. motor is used. When the start button is pushed the spindle revolves and automatically feeds down to a predetermined depth as set by the automatic counting switch, which then reverses it to the starting position and stops. The counting switch operates by the number of revolutions the spindle makes.

5,000-Ton Hydraulic Press Built for Aircraft Industry

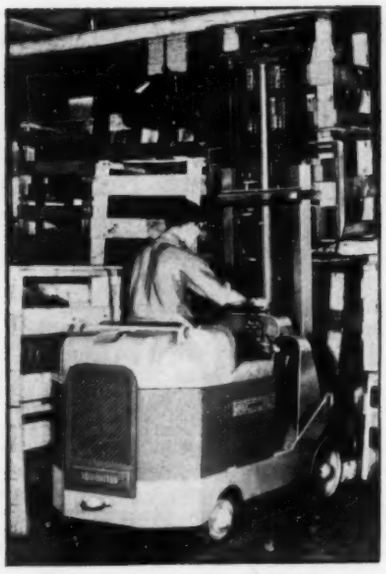
A 5,000-ton single action hydraulic press, furnished with rubber pad and steel bolster together with automatic motorized loading tables for high production of aircraft parts, has been announced by Lake Erie Engineering Corp., Buffalo, N. Y. This press is self-contained with pumping unit located on top. It combines fast operation, low-cost dies, quick changeover of dies, quick handling of stock and finished pieces, and convenient control of pressure, all of which result in high output and low costs on volume and limited production.

Pushbutton controls are grouped in conveniently located panels quickly accessible to operators. When two or more men are operating the press, controls interlock for safety so that press cannot be started until buttons on both sides are operated. Controls provide for starting, stopping, semi-automatic operation and inching. Press is provided with adjustable pressure and stroke control.



All-Purpose Lift Truck Handles Two-Ton Loads

Towmotor Co., 1228 E. 152nd St., Cleveland, Ohio, has introduced the Model LT-44 all-purpose lift truck capable of lifting 4,000 lb. at 15 in. from the carriage. With a 44-in. wheelbase and turning radius of only 72 in., it provides a range of lifting power and



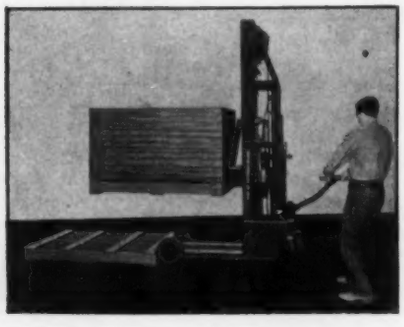
maneuverability sought in many fields today because of over-crowded quarters. Over-all width is 35 in. and over-all length (without forks) is 74 in. It is equipped with low, medium and high telescopic lifts up to 132 in. It is also available, in addition to standard load carrying forks, with interchangeable attachments for special purposes; rams, scoops, flat plates, special loading devices.

Powered by a 27½-hp. four-cylinder gas engine, equipped with degasser and governor, the Towmotor LT-44 travels at speeds from 1 to 10 m.p.h. with two speeds forward and two in reverse, achieved by a special transmission having only four gear elements. Because of its hydraulic lifting and tilting system, the unit will lift and stack its rated load accurately, to heights of 7, 9 and 11 ft., at approximately 40 ft. per min.

Hand-Operated Pallet Stacker Offered by Lewis-Shepard

Designed for use in place of large electric or gas operated fork-type tiering trucks, the transporting pallet stackers built by Lewis-Shepard Sales Corp., 245 Walnut St., Watertown, Mass., are claimed to offer outstanding economies:

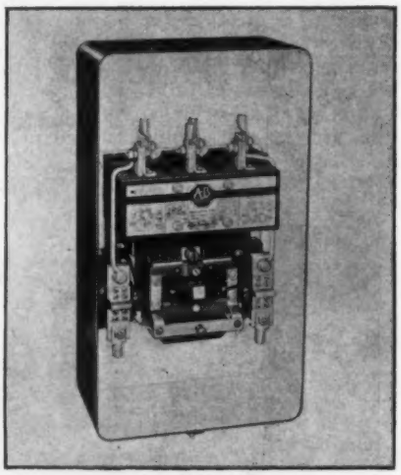
(a) Where merchandise must be shipped double-decked in freight cars to buyers who use double-faced pallets, but where total amount of handling such materials does not warrant the purchase of an expensive power fork truck; (b) as supplements to the big trucks in rush hours, cramped quarters, or remote parts of the building; (c) where the building elevator capacity prohibits carrying heavy trucks to upper floors; also where the floors themselves cannot support the weight of heavy power trucks; and, (d) in loading and unloading immediately adjacent to freight car doors, and on comparatively narrow docks.



New and radically different type of running gear permits operator (1) to approach stacker to pallet and throw lever, braking the wheels; (2) to continue pushing stacker while wheels remain stationary; stacker arms going into the upper pallet and base member into the lower pallet, (Wheelbase is now 19 in. instead of 52 in.); (3) to turn crank and raise load about 6 in.; (4) to pull stacker toward him, which returns stacker wheelbase to its normal 52 in. Over-all height of this stacker allows entrance to freight cars. The large easy-rolling floor wheels give ample underclearance for sills or ramps.

Larger Solenoid Starter Developed by Allen-Bradley

To meet the demand for a larger starter with the solenoid switch structure, Allen-Bradley Co., 1311 S. First St., Milwaukee, Wis., has developed the Size 4, Bulletin 709 solenoid starter. This unit, which has a rating of 50 hp., 220 volts and 100 hp., 440-550-600 volts, will replace the older Bulletin 710, Size 4 clapper starter.



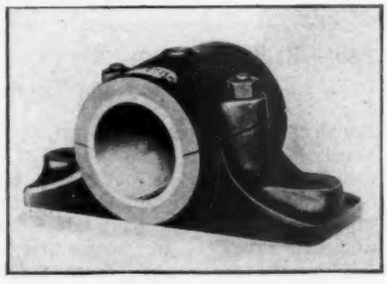
All the features of the smaller Allen-Bradley solenoid starters are incorporated in the new Size 4 solenoid starter. Contact cleaning, filing, or dressing is avoided by the use of cadmium silver contacts. There are no bearings, pivots, or hinges.

The double break, cadmium silver contacts are totally encased in an arc hood, each pole of the switch having its individual arc chamber. Hence, these starters can be closely grouped without danger of flash-over between switches.

Babbitted Common Flat Box Improved by Link-Belt

A streamlined babbitted-bearing common flat box (Series 2-1200), with maroon-colored crackle-finish housing, has been announced by Link-Belt Co., 2410 W. 18th St., Chicago, Ill. Designed for moderate speed and power requirements, it is available from stock in 24 sizes, for shafts of ½- to 3-in. diameter.

Design features include: compactness, with proper metal distribution to assure maximum strength and rigidity within minimum over-all dimensions; sloping surfaces between cap and base to maintain concentricity and relieve the cap bolts of direct strain from side thrust; removable shims between base and cap for adjustment; and cap bolts which do not protrude above top of bearing. The babbitt is of a balanced formula, selected in operative tests, for maximum service. Bore is broached to size with cap in place, to assure concentricity and proper running fit on shaft, with less friction and lower power consumption.



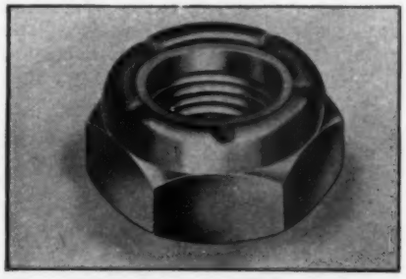
Bearing ends are finished to provide accurate bearing surfaces for collars, pulleys, gears, sprockets, or other limiting devices. Bearing cap is tapped for grease cup or hydraulic fitting. A groove in cape bore assures efficient distribution of lubricant. Base is accurately ground to close tolerances, maintained from base to bore center. Base is recessed to compensate for inaccuracies in surface of the structural support.

Thin Hexagonal Nuts Offered by Elastic Stop

For use on shear bolts where a high degree of the stress is lateral, and for general application to light and medium stress fastenings, an improved line of thin hex nuts is announced by Elastic Stop Nut Corp., 2332 Vauxhall Rd., Union, N. J. These nuts have approximately 40 percent of the strength of standard-height hex nuts and have been developed to meet the demand in virtually every industry

for a self-locking fastening which offers savings in space, weight, and cost. They are approved for use on aircraft by military and civil authorities.

As in standard height elastic stop nuts, the self-locking action is accomplished by a vulcanized fiber collar built into the nut head. This tough material resists the entry of the bolt, thus forcing the nut outward and taking up all thread play. The fiber, being non-metallic and of a resilient

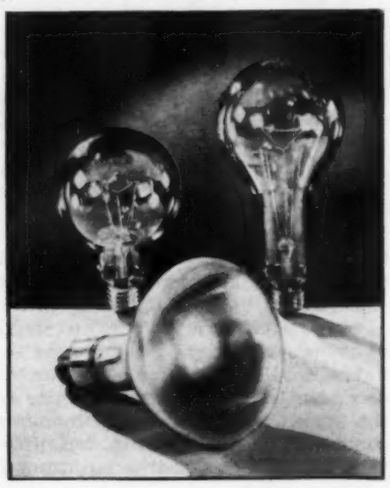


character, does not deteriorate under vibration, and so continues to hold the threads of nut and bolt in a constant pressure-contact.

The nuts are available in steel, brass and aluminum in a complete range of standard sizes, both coarse and fine thread.

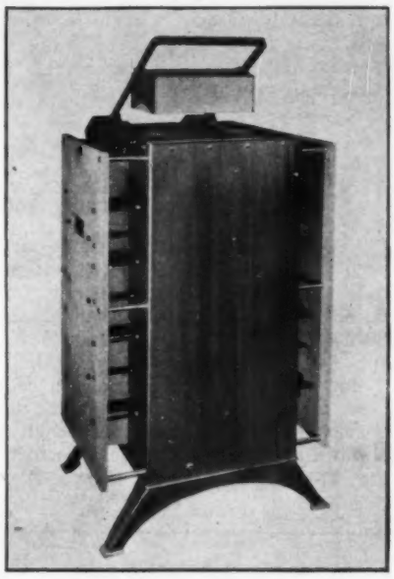
Birdseye Infra-Red Lamps Help Speed Finish Drying

Birdseye Div., Wabash Appliance Corp., Brooklyn, N.Y., has made available three new infra-red heat lamps especially developed for industrial finish baking applications. Two of the lamps are clear, for use with standard gold-plated or Alzac reflectors, while the third does not require any separate reflector is built with its own reflector lining sealed inside to keep it free from oxidation and the collection of dust, dirt and fumes. This reflector lining will keep its heat-reflecting value for the 6,000-hr. life of the bulb because it is made of solid silver sealed inside the gas-filled bulb. Differing from incandescent lamps used for lighting, the filaments of the Birdseye infra-red lamps operate at lower temperatures, developing infra-red radiant energy at wave length which have high penetration.



Sentry Pit-Type Furnace Employs Controlled Atmosphere

A controlled-atmosphere pit-type furnace for high-temperature hardening of high-speed steel has been designed by The Sentry Co., Foxboro, Mass. Its design allows the hardening of long tools in a vertical position and elimi-



nates any tendency of the tools to warp or change shape when hot. An automatically controlled neutral atmosphere is assured by the use of Sentry diamond blocks.

The furnace has a maximum rating of 32 kw. In normal operation, it will run from 8 to 20 kw. per hour. It will heat from cold to 2350 F. in about 75 min. It has a rugged steel shell and ample insulation for 2500 F. operation. Heating elements on either side of the removable silicon-carbide muffle, in four positions, assure uniform temperatures throughout the chamber. Shielded electrical terminals of a patented air-cooled design eliminate necessity for water cooling.

Over-all dimensions of furnace illustrated are: height, 52½ in.; width, 28⅞ in.; depth, 21½ in. Muffle dimensions are 4½x4x28 in.

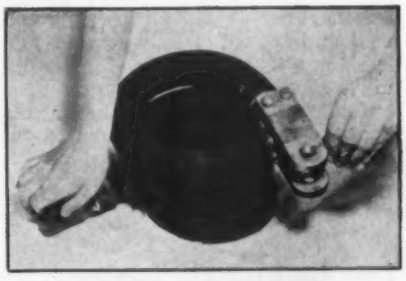
"On-Center" Safety Goggle Offered by American Optical

An "On-Center" safety goggle of the spectacle type has been developed by American Optical Co., Southbridge, Mass. Features of this sturdy, comfortable goggle include a double-braced bridge for hard usage; a design that conforms to the orbit of the eye; comfortable rocking pads; insulated, heat-resisting, perspiration-proof temples; three eye and bridge sizes for maximum comfort and efficiency; and the added protection of "Super Armorplate" Clear or Calobar lenses.

In addition, this goggle can be obtained with wire-mesh side shields which give extra protection against particles striking from the sides. These screens are non-corrosive and easily cleaned.

Kickless Welding Cable Made by Progressive Welder

A line of low cost kickless welding cables of full concentric design for reduced current loss and with positive and negative current strands wound at steep helical angles to increase ease of flexing and reduce wear is announced by Progressive Welder Co., 3050 E. Outer Drive, Detroit, Mich.



Developed in conjunction with Habirshow Cable & Wire Co., the "P-H" cables are available in a complete range of capacities to suit almost any portable welding gun.

These cables have a rated capacity 50 percent in excess of conventional cables of the same size, increased efficiency due to full concentric arrangement of copper, increased life because of extra heavy insulation and marked reduction of wear by external abrasion. Gun handling is thus made easier not only by the kickless feature

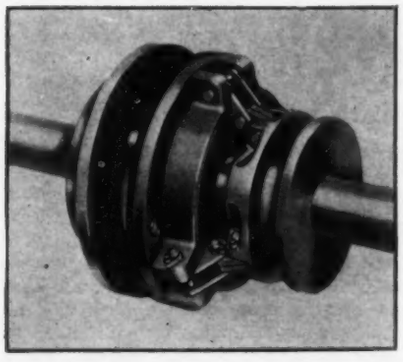
but also by virtue of the smaller cross-section of the cable.

The water supply core of the cable consists of ⅜ in. interlocked bronze tubing having high flexibility characteristics. Six current carrying bundles, of seven copper strands each, inclose this core and are so formed that any flexing causes them to unwind rather than bind. A heavy reinforced rubber insulating tube separates these inner strands from the outer strands which are also wound at steep helical angle. Between the outer strands and the external, extra-heavy abrasion resistant cable covering is space for water circulation.

Rockford LMC Clutch Transmits Up to 6 Hp.

Up to 6 hp., at speeds of 600 r.p.m., can be transmitted with the LMC clutch developed by Rockford Drilling Machine Div., Borg-Warner Corp., Rockford, Ill. This toggle type, over-center clutch is simple in construction and compact in design.

Operating links, pins and rollers are

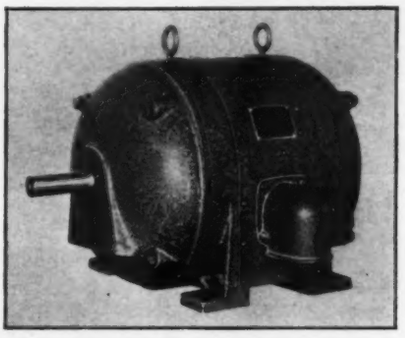


all of hardened steel. Clutch plates are of steel, hardened and ground. Driving pressure is uniformly distributed, and applied directly opposite facing where it is most effective. No oiling is necessary for the accurate metal bushing which carries the driven sprocket, pulley, sheave flange, or other parts of machine in which the clutch is installed. Steel end-plate is threaded for fine adjustment.

Lima Spatter-Proof Motors Feature Increased Protection

Increased protection against such hazards as water, abrasive dust and dirt is provided in the RS semi-inclosed spatter-proof electric motor offered by Lima Electric Motor Co., Div. of Lima Armature Works, Inc., 438 N. Main St., Lima, Ohio. These squirrel-cage induction motors are built in a large range of sizes for general and special applications.

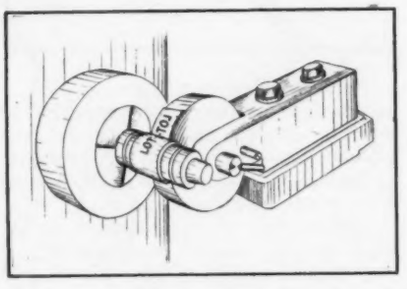
For general purpose drive, such as pumps, machine tools, etc., Type RS, with normal torque, normal starting



current, is recommended. For normal torque, low starting current applications, Type RSL is available. For installations such as air compressors, plunger pumps, etc., where high torque, low starting current is required, Type RSH motor has been made available. These motors are manufactured in sizes from 1 to 75 hp.

New Method Steel Stamp Offers Shell Marking Tool

Developed especially for marking parts such as shells or other ordnance units, indexing rolls, etc., while being produced on automatic screw machines, lathes, etc., New Method Steel Stamps, Inc., 143 Jos Capau St., Detroit, Mich., is now manufacturing a rotary or roll-type marking device, with solid die. Service installations on more than a dozen automatic screw machines turning 37-mm. shell have shown their



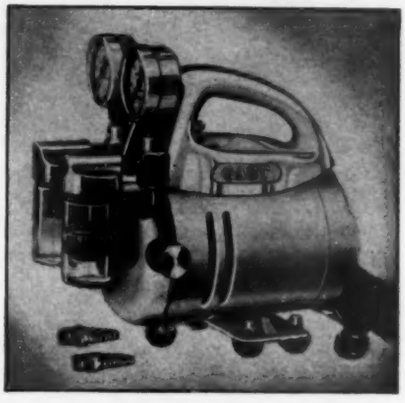
ability automatically to make clean-cut identifying marks in high production.

Marking roll fits into a holder which has a fine adjustment for starting the marking operation when the roll is brought into contact with the part. After completing the marking operation, the roll is returned to initial position by a coiled spring mounted on the end of the roll shaft. The roll is designed so that continuous contact with the part after marking does not cause it to rotate and remark the surface. Only a single impression is made, even though the part continues to rotate before the roll is withdrawn from contact.

Various forms of holder shanks are available so that the device can be adapted to most applications where the marking of rotating parts in production is required. Another type with interchangeable die has also been developed.

Gast Vacuum-Pressure Unit Intended for Accessory Use

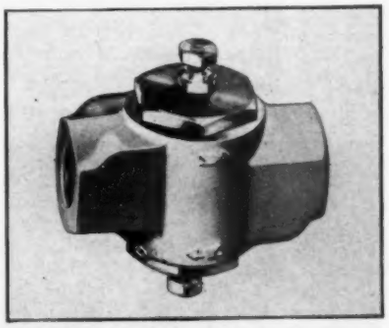
Powered by a 1/12 hp. motor, this vacuum-pressure pump offered by Gast Mfg. Corp., Hinkley St., Benton Harbor, Mich., is said to be unusually compact and light in weight. Intended for use as a machine accessory, the pump is of the rotary type operating without gears, springs or valves and



is claimed to be unusually efficient, vibrationless and quiet in performance. A slight adjustment converts pump from vacuum to pressure service. The unit measures only 8½ in. long and 4½ in. in diameter.

Hanna Speed Control Valve Operates in Two Directions

Hanna Engineering Works, 1765 Elston Ave., Chicago, Ill., has developed the



two-direction speed control valve illustrated for dependable speed control of pneumatically actuated cylinders.

Installed between operating valve and one end of a cylinder, a single valve provides adjustable control of inflow as well as exhaust of the air independently to and from one side of the piston. One valve will therefore control the piston speed in two directions. For extra sensitive adjustment

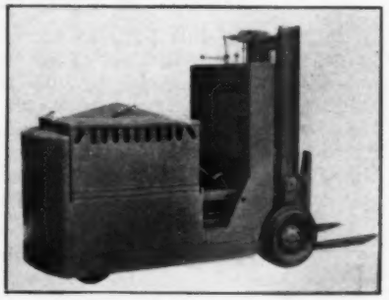
and control of piston speed, two control valves, one for each end of the cylinder, are recommended.

The valve is so constructed that the two adjusted orifices which control the airflow in the two directions are set before flow takes place. This insures control from the very start of movement. The valve body is cadmium plated and all other valve parts are made of corrosion-resistant materials. The device is recommended for 250 lb. pressure. It is available in ⅛, ¼, ⅜, ½, ¾ and 1 in. pipe sizes.

Full Contactor Control Used in Baker Fork Truck

Baker Industrial Truck Div., Baker-Raulang Co., 2168 W. 25th St., Cleveland, Ohio, has developed a heavy duty ram and fork truck incorporating full contactor control. This truck, rated at 10,000 lb. capacity is equipped with both 36-in. forks and a 36-in. ram. The forks lift to 60½ in. and the ram to 70 in.

Control apparatus employed is of the

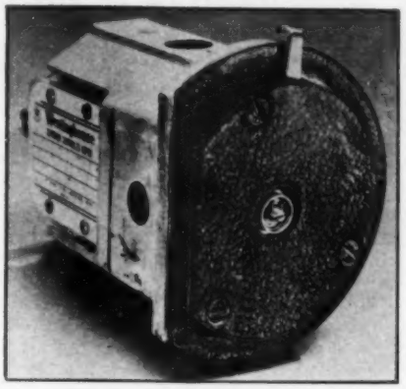


same design as used in transportation service—ruggedly built to withstand severe usage. Maintenance is low since the contactors are of the single unit type and are identical on the various motions. This results in interchangeability of contactors and reduces the number of renewal parts required. Contactors are mounted on the panel as individual units. Each contactor can be removed from the front. Contactors are equipped with nitrided bearings and pins which require no lubrication. The master switch is of the double brake cam type. Long life and low maintenance cost are assured by an automatic acceleration system. Interlocks are used on some of the contactors to guarantee proper progression of control.

This truck, incorporating all Baker design features, uses internal expanding hydraulic brakes on the drive wheels. These are easily adjusted and operated as service brakes by the pedal. Operation of parking brakes is mechanical by linkage interlocked with the control system and operator's platform so that the brakes are set and circuit broken when the operator leaves his station. Hoist brakes are magnetic dry disk type on motor shaft.

Fractional Horsepower Motors Are Governor-Controlled

Universal governor-controlled motors, available in sizes from 1/50 to 1/20 hp., have been developed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. These motors meet the need for a wide range of applications for quiet, constant speed, light-weight motor



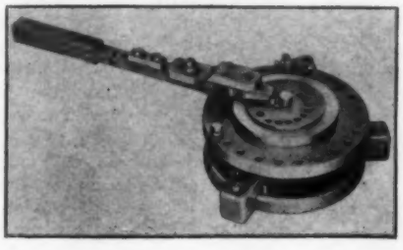
drives, in adding machines, calculating machines, check endorsers, typewriters, and other similar applications.

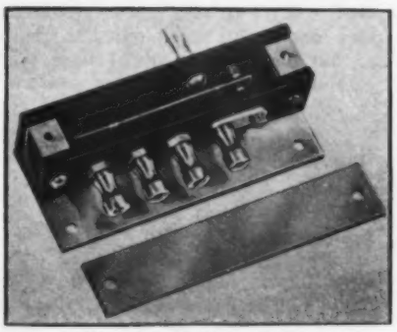
They are equipped with rotating contact or hinge type governors, or may have supporting arms for special type governors. Die cast housings of aluminum alloy make these motors extremely light, an important feature in small portable office machine applications.

O'Neil-Irwin Strip Bender Also Forms Seamless Tubing

The No. 2 "Micro" die duplicating bender offered by O'Neil-Irwin Mfg. Co., 316 Eighth Ave. S., Minneapolis, Minn., is capable of handling larger sizes of strip than previous models, and is also suitable for forming stainless steel tubing. It is also satisfactory for forming heavy busbars such as used in electrical power transmission, bending the material both on edge and vertically.

The device receives fixtures for forming all types of tubing for accurate contours with a rolling action whereby sliding in forming the tube is eliminated. This feature makes the device especially suited for aircraft fuselage construction work since reworking of the tubing is not required.





Time Delay Switch Made by Betts & Betts

Betts & Betts Corp., New York, N. Y., has developed the time delay switch shown to provide a predetermined time delay in electrical control. It is suitable for industrial application in conjunction with magnetic relays where temperature changes are fairly constant and slight variations in timing are not detrimental.

The switch is provided with four terminals, two for the heater coil and two for the main circuit. It is adjustable within the time limits of one second to five minutes. It is available in immediately or not immediately recycling types and in normally open or normally closed contact types. Complete switch measures only 3x⅞x⅞ in.

Steel Tiering Dump Box Used With Revolving Forks

A corrugated steel box, designed especially for use with lift trucks equipped with revolving type forks, has been introduced by Union Metal Mfg. Co., Canton, Ohio. Special fork pockets welded to the bottom at either end run the full length of the box. When the forks are inserted in these two pockets, the box can be lifted, turned

completely over for dumping, then righted again.

Top flange of box can be equipped with tiering or crane lugs for efficient storage and handling. Ends of the pockets are cut at a 45 deg. angle so that they do not extend beyond sides. Casters facilitate short spottings and

permit box to be moved easily between machines. Rugged, all-steel construction, combined with the dumping feature, makes this unit particularly suited to handling scrap, small metal parts, castings, and various loose materials.

New Strip-Chart Recorder Introduced by Bristol

A newly designed strip-chart recorder is offered by the Bristol Co., Waterbury, Conn. Many changes have been made in the construction of these instruments, including the case design,

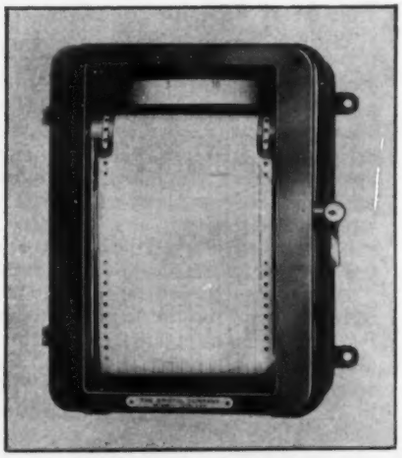
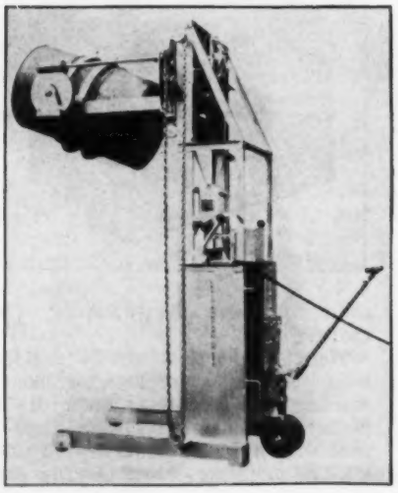


chart drive, measuring elements and writing mechanism.

They are available for recording on a 6-in. strip chart: d.c. volts and millivolts, d.c. amperes and milliamperes, pressure, liquid level, flow, temperature, motion and for remote recording, using Bristol's "Metameter" system of telemetering.

Drum-Dumping Stacker Is Controlled From Floor

Lewis-Shepard Sales Corp., 245 Walnut St., Watertown, Mass., has developed an improved drum-dumping stacker, which permits control of dumping by



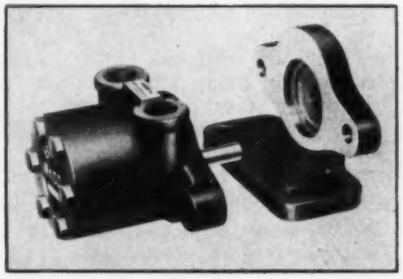
the operator from the floor. This eliminates standing on boxes, improvised platforms and the like.

A self-locking worm makes it possible to hold the drum instantly for as long as desired at any position. Control from the floor also permits the operator to reverse the tilt of the drum or barrel to slow down or stop the flow of material from the container.

B. & S. Rotary Geared Pump Develops 100 Lb. Pressure

The No. 00 rotary geared pump offered by Brown & Sharpe Mfg. Co., Providence, R. I., is intended for service where a small flow at pressures up to 100 lb. per sq. in. is needed. It utilizes helical gears to provide smooth, quiet operation at speeds up to 1750 r.p.m. This pump is suitable for lubricating, transfer or hydraulic service.

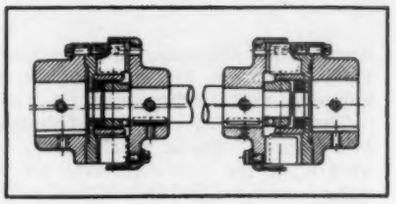
The pump is entirely self lubricating, no external lubrication being required. Gears are of heat-treated steel made separately from the case-hardened shaft. Shafts turn directly in the cap and end stand, no separate bearing being used. An oil seal prevents leak-



age. Design of the pump is simple and compact. Flange mountings adapt pump for direct motor drive, and for assembly as an integral part of a machine. The pumps run in one direction only, either clockwise or counterclockwise.

Lovejoy Flexible Coupling Made for Floating Shafts

A floating-shaft flexible coupling has been announced by Lovejoy Flexible Coupling Co., 5009 W. Lake St., Chicago, Ill. This coupling, designated as L-R Type HKQ, is applicable to either horizontal or vertical drives, and is recommended for long distance drives where the space between the driver and the driven units cannot be successfully handled by standard couplings; and especially where there is excessive misalignment. The floating shaft is supported in fixed bearings, entirely independent of the power-transmitting elements—which are thus entirely unaffected by forces generated by the floating shaft itself, and do nothing except transmit power. Other advantages secured by this construction include concentricity of the ends of the fixed shafts, thus eliminating



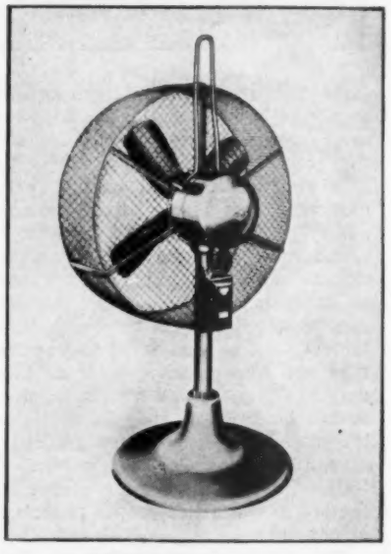
whipping of the ends of the shafts.

Three types of cushions are used: "Metalflex", a long-wearing brake lining material, used where heavy loads develop (at speeds not exceeding 300 r.p.m.); oak-tanned belting leather, for use on sustained loads with infrequent or no cyclic variation; and "Multiflex", a vulcanized duck and rubber material for fluctuating loads, the absorption of vibration, and maximum misalignment. These free-floating load cushions are held in position by a steel retaining collar.

L-R Type HKQ couplings are made in standard sizes, with bores from 1½ to 8½ in. (7 to 800 hp. at 100 r.p.m.) for various distances between fixed shafts.

ILG Man-Cooling Fan Designed for Heavy Duty

A 36-in. heavy-duty portable floor fan which hurls a 90-ft. blast of air in a straight line is offered by the ILG Electric Ventilating Co., 2850 N. Crawford Ave., Chicago, Ill. Self-contained, completely equipped and ready to handle any heat problem, it is especially valuable in man-cooling capaci-

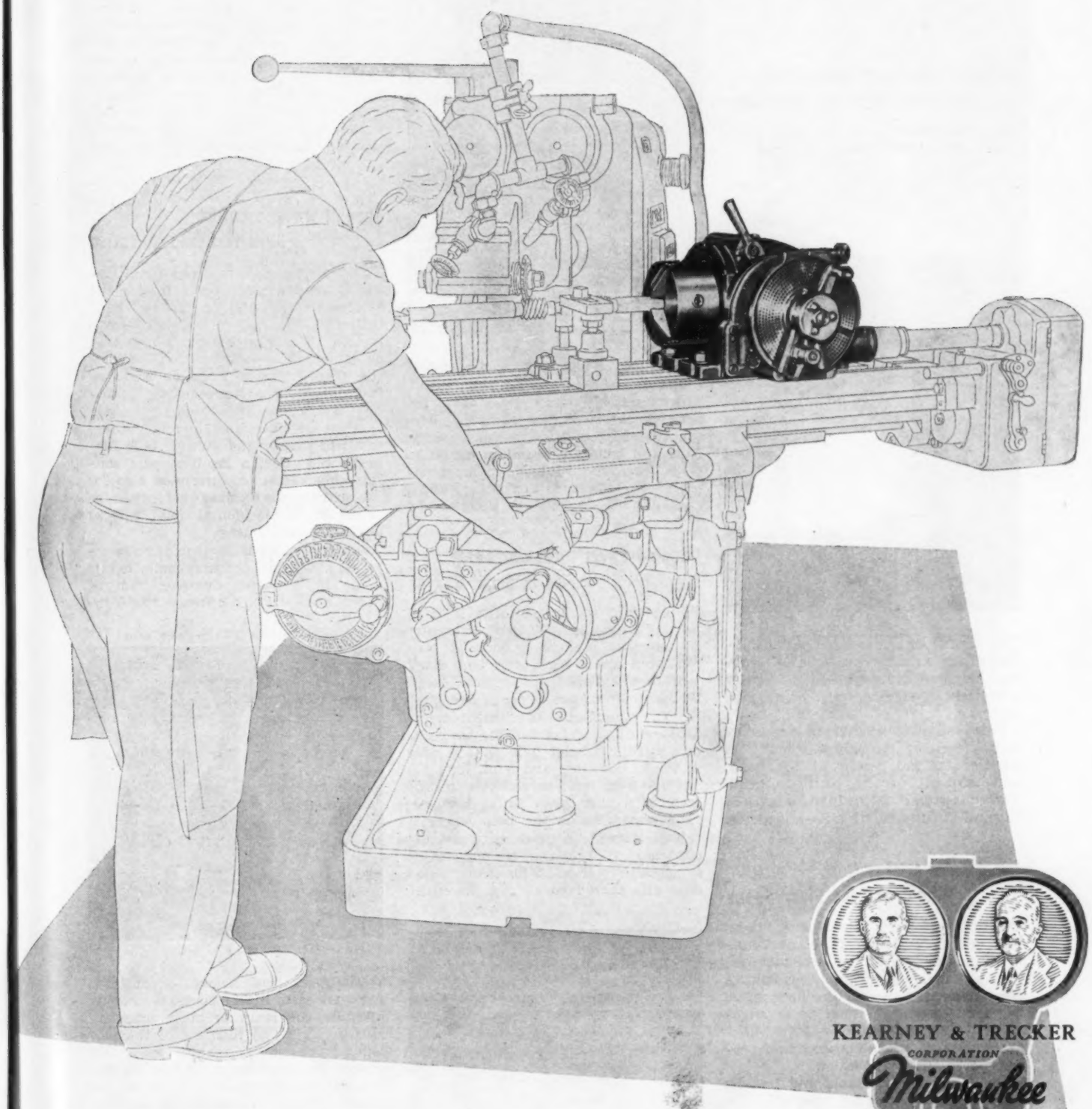


ties. It can be placed anywhere, affording a practical and economical means of relief to workmen in areas of intense heat.

Equipped with a cast-iron base of extra-heavy construction, this fan has a very low center of balance. It can be safely moved on a scoop truck, and a hook is also provided so that it can be moved by a crane if desired. A starting switch completes the equip-

The Model K Spiral Universal Dividing Head — a super-precision dividing instrument is built to provide a long lifetime of production service.

KEARNEY & TRECKER CORPORATION • Milwaukee, Wis., U. S. A.



KEARNEY & TRECKER
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Milwaukee
MILLING MACHINES

Milwaukee MILLING MACHINES

ment on the fan. The propeller is of the four-blade type, of one-piece metal construction, keyed to the motor shaft. Heavy steel mesh guards cover the fan in front and back, providing complete protection of fan and user.

The 36-in. heavy-duty model weighs 675 lb., attains 1140 r.p.m., and circulates air at a rate of 24,000 cu.ft. per min. Over-all height is 67 in. Guard diameter is 43 in.; base diameter 32 in. Other models of the man cooling portable floor fans, with the same general features but not of extra-heavy construction, are available in sizes of 36, 30, 24, and 12 in.

Eastern Centrifugal Sump Pump Features Automatic Operation

One of the features of the No. 2 sump pump offered by Eastern Engineering Co., 45 Fox St., New Haven, Conn., is a completely encased toggle switch with a large copper hollow float to assure positive automatic operation.

This centrifugal pump is especially intended for automatic removal of seepage, overflow, drainage and floodwater from cellars, elevator pits, boiler pits, etc.

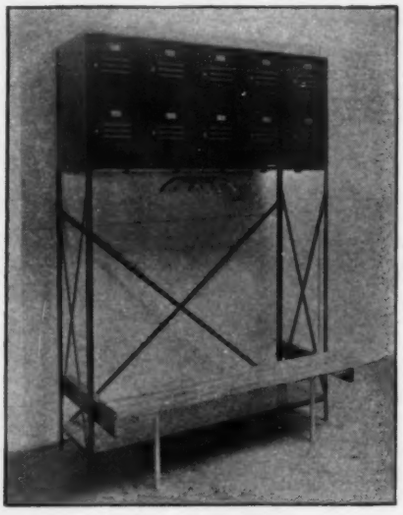
Float adjustment can be made by mere turn of a thumb screw. It handles 2200 gal. per hr. at 2-ft. head, and 1800 gal. per hr. at 10-ft. head. The unit stands 38 in. high, weighs 68 lb., and is powered by a ¼-hp. motor.

Penn Metal Locker Unit Requires Less Floor Space

The "Pen-Kelsey" steel locker units built by Penn Metal Corp. of Pennsylvania, 36 Oregon Ave., Philadelphia, Pa., are claimed to provide facilities for ten persons in half the floor space ordinarily required. Such an arrangement of lockers releases extra floor space for productive purposes and provides maximum ventilation.

Each low-cost, portable unit has an open coat space 56½ in. high with the coat hangers permanently attached to the rod. There is a perforated metal shoe rack at bottom, a wooden seat 8½ in. wide 18 in. above the floor, and ten private, locked compartments, each of which is 12 in. wide, 18 in. deep, and 12½ in. high.

Doors are flanged on all sides for strength, with three ventilating louvres per door. Optional locking arrangements are a flat key lock with bevel



spring-bolt or dead bolt, a spring-bolt combination lock or a padlock. Heavy furniture steel is used in the assembly, with compartment door frame members spot welded for strength and rigidity. Nuts and bolts are cadmium plated to resist corrosion. Rubber bumper silencers are employed at contact points. Over-all size of unit is 60x18x87 in.

"Sealed Silver" Tubular Lamp Fits in Small Spaces

To meet the requirements for a small tubular lamp that will burn at greater efficiency to produce a flood of concentrated direct light, and lend itself well to installation in narrow places, Wabash Appliance Corp., Brooklyn, N. Y., announces its "sealed-silver" Birdseye tubular lamp. This lamp fits into a T6½ tubular bulb that is only ¾ in. in diameter and 5 in. long. It has its own built-in reflector in the form of a pure silver lining hermetically sealed inside the bulb where it cannot tarnish or lose in operating efficiency. Its brilliance is increased by a special "coil-coil" filament, coiled once and then recoiled over its entire

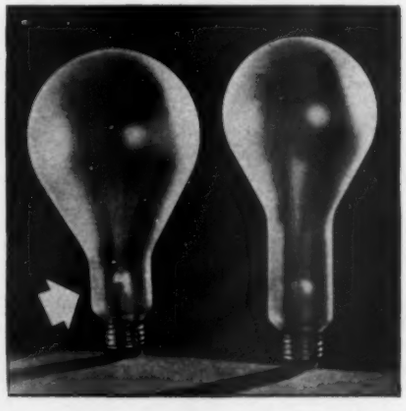
length to provide a more concentrated and economical light. Three metal supports anchor the filament in place and protect it against vibration.

The manufacturer reports this is the first time it has been possible to manufacture a built-in reflector lamp in so small a diameter with the filament so close to the bulb walls. The new Birdseye lamp is especially used for localized lighting on various machines to illuminate scales, micrometer readings, or special operations. Its built-in reflector floods a brilliant concentration of light exactly where it is needed. Focusing the light beam is accomplished by turning the bulb in the socket, as the spring clip keeps contact in the socket no matter which way the bulb is turned. It has an intermediate base and comes in 15-, 25- and 40-watt sizes, all of which are in the one bulb size, and has an average burning life of 1,000 hours.

Special Wabash Lamps Built to Stand Vibration

To overcome vibration, jar and shock which ordinarily seriously impair the efficiency and life of electric light bulbs, Wabash Appliance Corp., Brooklyn, N. Y., has announced a new type of lamp whose construction protects the filament from vibration and jar. It is designed particularly for industrial use where high-frequency vibration set up by motors and machinery tends to weaken the average bulb filament and shorten its life span considerably. It is recommended also for use in hanging fixtures that might be subjected to accidental jolts, shocks and other rough usage.

In appearance it has the same overall length as an ordinary bulb, but is made in a larger oversize bulb of wider diameter to increase the con-



vectivity of the heated argon and nitrogen gases inside the bulb, thereby allowing the lamp to burn considerably cooler. The filament of the new lamp is cushioned against shock and concussion of vibration by four molybdenum pigtail springs welded to six flexible filament supports. The entire stem unit has been shortened and made

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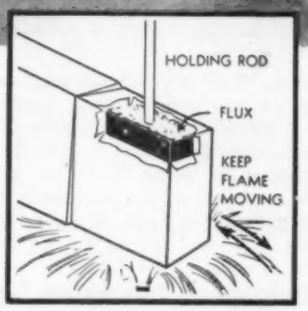
Illustrated above are a few of the many Carboloy tools used by a well-known brass goods manufacturer. They range from complicated forms to the most simple types. All are regularly made in their own shop. The method is simple, economical, fast!

Complete instructions on how to make your own Carboloy tools are contained in our Engineering Bulletin GT-116 available upon request, without obligation. Investigate this "short-cut to speed-up."—Write for your copy today.



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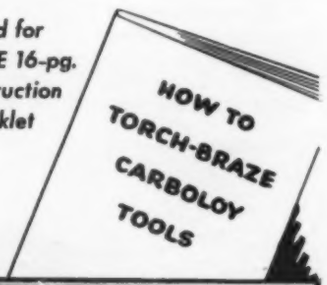

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flexible. To increase lighting efficiency a nickel neck reflector disk welded to a seventh support serves to reflect light away from the neck of the bulb, while a center piece of mica insulates the wire supports from the disk and helps keep heat away from the base.

The lamp is made in 100, 150 and 200 watt sizes in five voltages from 110 to 130 volts, and in four voltages from 220 to 250 volts. Standard finish is either inside frosted as illustrated, or clear. Average burning life is 1,000 hours.

Westinghouse A.C. Tachometer Has No Commutator or Brushes

To eliminate undesirable features of the conventional d.c. tachometer, the Newark Works of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has developed the a.c. tachometer

shown. In this instrument neither brushes nor commutators are used in the non-sparking generator unit. The a.c. voltage generated is rectified and indicated in terms of r.p.m., gal. per min., or other units depending on the application.

"Resistoflex" Transparent Gloves Protect Hands From Solvents

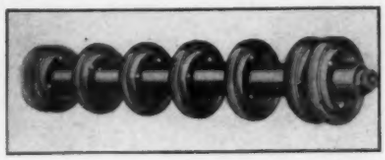
"Resistoflex PVA" transparent gloves have been developed by Resistoflex Corp., Belleville, N. J., expressly to prevent oils and solvents from coming into contact with the skin. They are said to provide complete protection against such insoluble sulphur-base cutting oils as are frequently used with screw machines and in other precision machining operations.

Containing no surphur, these gloves are claimed to cause no tarnishing of metal surfaces with which they may

come in contact. It is said that inspectors can use them to advantage in handling such finely polished metallic surfaces as on ball bearings, aircraft parts, etc. The gloves are claimed to have high resistance to tearing and abrasion. They are available in four sizes from 8 to 11 and in three lengths from 10½ to 18 in.

Belt Conveyor Return Idler Provided With Rubber-Tread

Development of a line of rubber-tread idlers for supporting the return run of 14 to 60 in. wide belt conveyors is announced by Link-Belt Co., 220 S. Belmont Ave., Indianapolis, Ind. Each complete idler consists of four to



twelve 6-in. diameter rubber-tired rolls suitably spaced and mounted on a "Friction Fighter" roller-bearing-equipped steel tube that will fit into the same supporting hangers as the regular Link-Belt return idler roll. Individual rolls consist of a renewable extruded rubber tire clamped between two steel disks firmly held together by three round-head bolts. As the rubber tire is split, it can readily be replaced when required.

The idlers are especially recommended for conveyors handling corrosive, abrasive, wet, or sticky materials, because (1) there is only a rubber-to-rubber contact between return idler and the under-side of conveyor belt, and (2) the kneading action of the rubber treads keeps the material from building up, also helping to break up and loosen ice forming on the belt in freezing weather.

G.E. "Tri-Clad" Motors Made in Splashproof Types

A line of "Tri-Clad" splashproof, ball-bearing, polyphase induction motors in sizes from 1 to 15 hp. has been announced by General Electric Co., Schenectady, N. Y., to supplement its recently announced "Tri-Clad" polyphase and single-phase open general-purpose lines. The new line is especially designed to meet the needs of applications where splashing water and other liquids are present.

As in the open motors, the splashproof line features functionalized styling and protection against physical damage, electrical breakdown, and operating wear and tear. Outstanding features include sturdy cast-iron stator frame and end shields that resist rust and corrosion. "Formex" wire windings highly resistant to moisture, and thoroughly protected ball bearings.

The ventilated openings of this

motor's stator frame and end shields are carefully baffled to block the entrance of splashing liquids. An ingenious arrangement of cast baffles within the side openings of the stator frame effectively blocks splashing from the side.

Pneumatic Conveyor Roller Absorbs Excessive Shock

Stephens-Adamson Mfg. Co., Aurora, Ill., has developed style No. 711 pneumatic roller for carriers on belt conveyors for use wherever shocks or impact are excessive. These pneumatic carriers are specially designed for use under loading spouts and in belt feeders where the impact of heavy bulk loads subject both conveyor belt and carrier to abnormal strains and wear. To cushion the impact of materials (and thereby prolong conveyor belt life), the rollers in these carriers are made up of a series of pneumatic rubber units 6 in. in diameter.

The rollers are mounted on the steel

hub in which bearings and shaft are housed. Roller units have thick, wear-resisting treads and are inflated and permanently sealed to prevent loss of air. The assembly is built for easy servicing and quick replacement of damaged units.

"Midget" Explosion-Proof Pump Offered by Eastern Engineering

Eastern Engineering Co., 45 Fox St., New Haven, Conn., has developed the Model D "Midget" explosion-proof pump for use in any industrial application where explosive hazards may exist. Of compact construction and rated for continuous operation, this pump is powered by a 1/12 hp. sleeve

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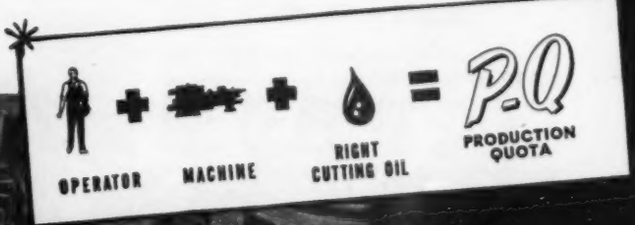

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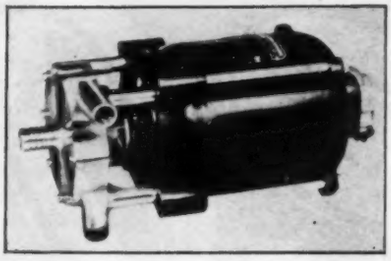
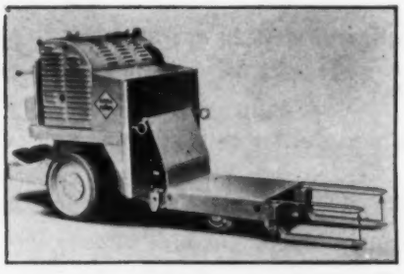


bearing 60-cycle induction motor. Motor armature and pump impeller are mounted on the same shaft, making a coupling unnecessary and assuring perfect alignment. The unit is 10 in. long, 5½ in. high and 5 in. wide. It weighs 18 lb.

Special Platforms Available For Elwell-Parker Trucks

Special platforms equipped with removable forks are now available for this standard type low-lift power industrial trucks built by Elwell-Parker Electric Co., Cleveland, Ohio. When attached to platform trucks in low position, the 30-in. forks lift and transport loaded pallets from floor level. The same fork extensions when inverted will pick up and transport long skid loads on the truck platform. The latter is 10¾ in. high in low position and elevates to 16½ in.

The truck is operated by storage battery. Dynamic braking can be obtained for ramp operation. Raising and lowering of platform are effected through an independent motor and screw ram. The lift jack has but three moving parts. A slip clutch protects

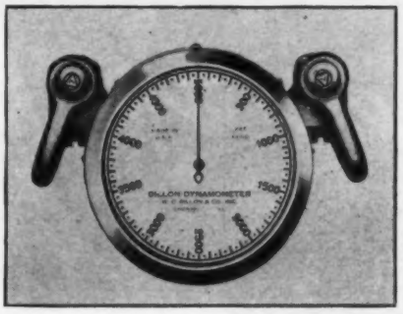


the motor in case of overload. Construction is rugged, but simple, with extra heavy welded frame and solid bar center sills providing a low center of gravity.

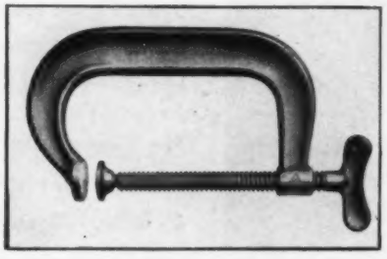
Dillon Tension Dynamometer Measures 15,000-Lb. Load

Seven models, capable of handling loads up to 15,000 lb., are available in the tension dynamometer offered by W. C. Dillon & Co., 5410 W. Harrison St., Chicago, Ill. This device can be used wherever it is important to know the stress on wire, flat metals, rods, castings, belts, chains, cables and other machine elements. It can also be used in a tensile strength testing machine for making sustained or breakdown tests on materials.

Rugged construction helps maintain precision despite rough handling. Dials are of heavy brass finished in satin-chrome with clear, easy-to-read divi-



sions. Crystal protecting the dial is of shatterproof glass. Each dynamometer is individually calibrated for accuracy. The mechanism is designed to withstand a 100 percent overload and a full shock recoil.

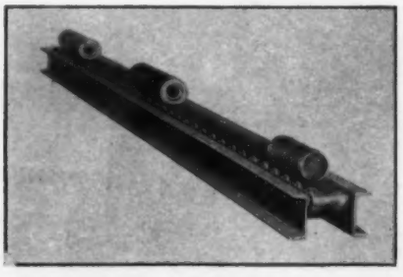


Spatter-Resisting Clamp Built for Welding Service

J. H. Williams & Co., 225 Lafayette St., New York, N.Y., is offering a special spatter-resisting finish on this drop-forged C-clamp which resists the adherence of welding spatter to the body, swivel and screw. These completely cadmium-plated clamps are available in seven sizes, with opening ranges from 2 to 12 in.

Concave Roller Conveyor Handles Cylindrical Objects

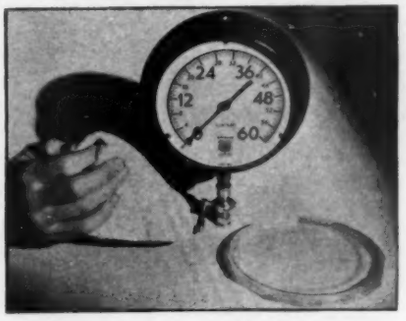
Standard Conveyor Co., North St. Paul, Minn., has developed this concave roller conveyor for handling shell and other cylindrical objects up to 6 in. in diameter. Rollers are formed



from 2¼-in. 10-gage tubing. The roller ends are reduced in size and reamed to form a seat for the bearings without any separate hubs or cages. Hexagon through shafts serve the dual purpose of locking the bearing to the shaft and the shaft in the frame. This prevents turning and undue wear, and insures uniformity at roller carrying surface even after long service.

Plastic Gage Dial Offered By Manning, Maxwell & Moore

Release of valuable aluminum for defense needs is one of the features of the plastic "Duradial" gage dial developed by the Ashcroft Gauge Div., Manning,



Maxwell & Moore, Inc., Bridgeport, Conn. A further advantage is said to be that the plastic is superior in many respects to aluminum for this particular application. The plastic dial can be easily washed, and it will not warp, corrode, rust, crack or otherwise deteriorate.

The dial is made like a sandwich with the graduations permanently sealed between layers of clear plastic. The face is pure white without gloss, and the markings are jet black. This laminated plastic dial is to be used on all Ashcroft Navy gauges, "Quality" gauges, and "Duragauges" at no extra price.

Kennametal Boring Bits Intended for Use on Steel

A standard type of carbide-tipped boring bit that will give efficient service on most steel boring operations, while requiring minimum grinding alterations for special boring jobs, has been placed on the market by McKenna Metals Co., 103 Lloyd Ave., Latrobe, Pa. This bit has a 12-deg. positive back rake as contrasted to the 2-deg. negative back rake used on standard Kennametal-tipped turning tools. This positive back rake, combined with a compound front clearance angle, provides firm support to the cutting edge while allowing ample clearance. When used on average boring jobs, this tool will provide an effective back rake of −4 to +4 deg. depending upon the diameter of the bore.

The front clearance angle on the tip of the tool is 0 deg., providing an effective cutting clearance of 4 to 10 deg.

for the average bore. The secondary clearance of 10 deg. on the shank permits the tool to fit in holes without rubbing on the heel. On very small holes, the heel of the tool may be chamfered to assure ample clearance.

While the back rake and clearances are standard for the new Kennametal boring bit, side cutting edge angles and end cutting edge angles vary for six standard styles in which the tool is supplied. The various combinations of edge cutting angles will be found effective for most boring jobs where bits are held in the boring bars from a 90- to a 45-deg. angle—both for boring straight through and for cutting up to a 90-deg. shoulder. The right- and left-hand tools for the six standard styles of boring bits are listed as Styles 23 to 24 inclusive. Kennametal tips on these tools permit high cutting speeds on steel up to 550 Brinell, with close tolerances, greatly reduced tool wear, and an absence of "cratering" from steel chips.

Soft Rubber Polishing Wheels Produce High Lustre on Metals

Highly polished surfaces on any base metal can be created with the soft rubber polishing wheels introduced by Chicago Wheel & Mfg. Co., 1101 W. Monroe St., Chicago, Ill. In these wheels five different types of polishing compound are impregnated into a special rubber binder. There is sufficient cutting grit to remove scratches and grinding marks from the piece being polished. It is said that on many operations the use of set-up wheels can be entirely eliminated.

No special equipment is required in using these wheels. They are available in a complete range of sizes, and in sticks and sheets for hand lapping. Conventional dressing tools are used to dress the faces of wheels to any desired contour so that irregular castings can be polished with ease. Any coolant which is not a solvent of rubber can be used where it would be desirable.

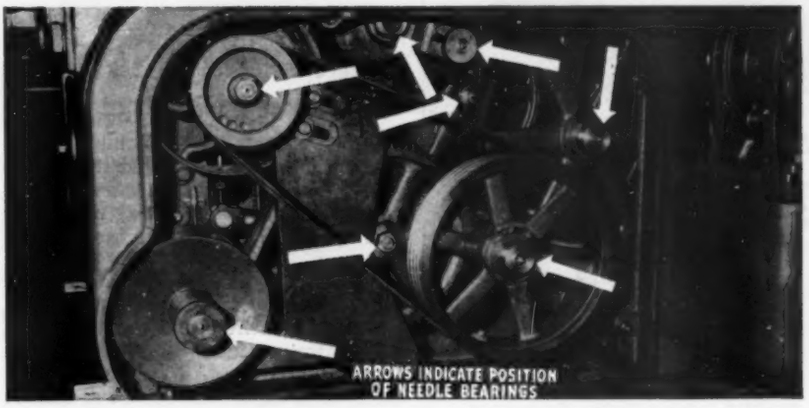
The special bond requires less pressure in getting the desired finish. Due to the wide variety of combinations which can be incorporated in any one wheel, they present definite possibilities in eliminating as many as three graduations of set-up wheels. They are not suitable for polishing plated work.

NEW MATERIALS

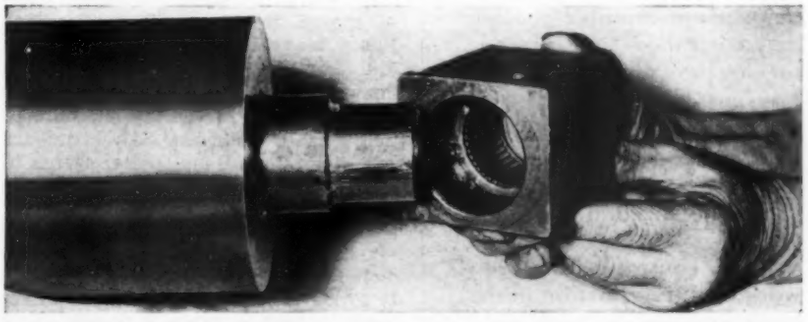
"Floor-Patch" Compound Repairs Holes in Concrete

Holes, ruts and worn places in concrete floors can be repaired easily with "Floor-Patch" offered by Truscon Laboratories, Detroit, Mich. This compound is said to produce a non-shrinking patch which adheres tightly to the surrounding concrete surface. It is neither

TORRINGTON NEEDLE BEARINGS TAKE HEAVY LOADS IN WHITNEY PLANERS



THIRTY NEEDLE BEARINGS are used in the big new Whitney No. 97 Production Wood Planers. "We have selected Torrington Needle Bearings because of their heavy load capacity and extreme compactness," states Mr. E. D. May, Chief Engineer of Baxter D. Whitney & Son, Inc. "Other bearings would increase the size of housings and necessitate staggering for clearance."



LARGE ROLLERS of the Whitney Planers rotate on anti-friction Needle Bearings which take no more space than plain bushings. The precision-ground rollers and hardened outer race form units that are quickly and inexpensively installed. They require a minimum of attention because lubricant is long retained. Initial costs of Torrington Needle Bearings are surprisingly low.

Have you considered the advantages of compact, highly efficient Torrington Needle Bearings for your product? They may greatly improve its design and construction while keeping costs low. Our Engineering Department will be glad to help

you plan their inclusion in your equipment. For full details write for Catalog No. 105. For Needle Bearings to be used in heavier service, request Booklet 103X from our associate, Bantam Bearings Corporation, South Bend, Indiana.

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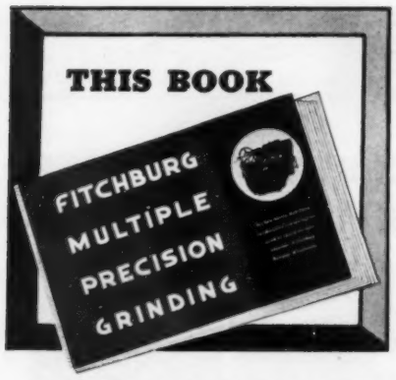

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Write for it today. Photographs, operating diagrams and large clear quick reading text show you how Fitchburg-built equipment enables you to make the same kind of savings on grinding that you now enjoy from multiple tooling and combined cuts on your turning jobs. Fitchburg special mass production grinders utilize standard Bowgage Wheelhead units — easily adaptable to other work if operations change or discontinue. Bowgage principle gives increased accuracy control on precision work. Full information in the book — free to executives. Write for it today on your business letterhead.

FITCHBURG

GRINDING MACHINE CORP.

FALULAH ROAD

FITCHBURG, MASS., U. S. A.

a tar, asphalt nor portland cement product.

The compound is adaptable to overnight repair work, as floors may be used for light traffic the following morning. It eventually sets harder than the concrete itself and withstands extreme pounding without breaking up. It is supplied in 10 lb. cans and 50 lb. drums, ready for use. Only water need be added. The color is approximately that of the usual concrete.

"Alubro-Weld" Blue Glass Intended for Aluminum Welding

Willson Products, Inc., Reading., Pa., has developed the "Alubro-Weld" blue glass especially to filter out injurious light rays resulting from welding aluminum and bronze. Although this glass has a higher visible-light transmission than average blue glass compounds, it is claimed to block out harmful ultraviolet rays entirely and greatly to reduce injurious infra-red ray transmission. It is said that welders can see their work better through these glasses and control the flow of metal more easily without danger of eye injury.

"Fas-Tin-Flux" Offered By Hanson-Van Winkle-Munning

A special tin flux called "Fas-Tin-Flux," made by Hanson-Van Winkle-Munning Co., Matawan, N. J., is a liquid of the zinc chloride type for use in hot tinning, in the manufacture of Terne plate (lead-tin alloy) and for soldering. Containing special agents to assure fast action, it is so made that it is free from uncombined hydrochloric acid.

"Fas-Tin-Flux" may be poured on molten tin without danger of explosion. It forms a foamy flux blanket, which tends to harden unless it is constantly supplied with water by a drip. This is intentional because zinc chloride is most effective as a flux when water is supplied with it to form hydrochloric acid gas in the fusion. Increased use of water leads to brighter coats.

"Marlox" Plastic Coating Protects Metals from Rust

"Marlox" plasting coating for metals, introduced to the industrial market by Marley Chemical Co., 983 E. Milwaukee, Detroit, Mich., protects against rust and corrosion. Unlike ornamental plastic coatings, which lack weather-resisting qualities, "Marlox" is a plastic coating of the structural type, used for doing a tough job. This product is used either as a priming coat, or purely for protection against rust and corrosion.

Chief among many advantages claimed for "Marlox" is almost complete absence of porosity, as compared with coatings made from oils and pigments. Too, this product is said to exclude the air film present in such materials. It is successfully applied by spraying, painting or dipping, forming a thin, flexible coating on any metal to which it is applied—so flexible that it is not affected to any noticeable degree by temperature changes. The same quality of flexibility, plus unusual adhesion, makes "Marlox" of particular value in coating welds. Here it furnishes adequate protection against corrosion and rust-creepage in the seams and folds, right up into the welded spot. As a base coat, it provides a tough, durable bond between metal surface and any kind of finishing coat.

Used to inhibit rust and corrosion, it is applied to a thickness of 0.00005 in. Used as a prime coat, it is applied to a thickness of 0.0005 in. Dilution with "Solveso" is recommended, a gallon of finished mixture covering from 1,000 to 2,000 sq.ft. of metal surface. The compound dries quickly, and can be handled in five to ten minutes after applying. One hour's drying time is recommended where possible, before applying enamels or paints. It may be applied to all types of metals and alloys including steel, cast iron, aluminum, aluminum alloys, magnesium alloys, copper, brass, cadmium plate and galvanized or zinc coated steel. Where weight is a factor, as in airplanes, "Marlox" saves 50 percent of the weight of the conventional primer.

Enthone Blackening Process Coats Zinc and Its Alloys

Enthone Co., 442 Elm St., New Haven, Conn., has developed an immersion process for blackening zinc and its alloys. The process, called "Ebonol Z", consists of immersing the zinc or zinc alloy in a 1 lb. per gal. solution of "Ebonol Z" salts at a temperature of 150 to 212 F. An adherent, jet-black finish is formed in 1 to 5 min.

The work is cleaned in alkaline cleaners or degreased with solvents and acid dipped similarly to preparing work for plating, before being treated in the blackening solution. A single pound of salts blackens over 150 sq.ft. of zinc surface. The bath is not critical and requires little control. It can also be used for producing a black coating on stainless steel, nickel silver, nickel, and noble metals, by making a couple with these metals and a piece of zinc. This can be done by using a zinc basket or by fastening a sheet of zinc to the rack or basket in which the metals are to be blackened. The process is suitable for nameplate finishing where recesses are to be blackened.

It can be used for blackening zinc plated or hot galvanized surfaces, as well as for solid zinc or its alloys. For armament purposes, it allows the blackening of zinc and other metal surfaces to reduce glare and, in addition, the thinness of the coating obviates difficulties from a dimension tolerance standpoint. Unlike plated or enameled coatings, "Ebonol Z" coating does not change the thickness of the piece more than a few hundred-thousandths of an inch, and thus close dimensions can be maintained.

TRADE PUBLICATIONS

AIR COMPRESSORS Schramm Inc., West Chester, Pa., is circulating a two-page leaflet, No. 4120, which illustrates, describes, provides specifications, and lists prices of air compressors.

ARC WELDERS Ideal Commutator Dresser Co., 1268 Park Ave., Sycamore, Ill. has issued a two-page leaflet which illustrates, describes, and provides specifications for "The Weld-Master" electric arc welder.

CHUCKS Erickson Steel Co., 80th and Bessemer Ave., Cleveland, Ohio, has published an eight-page folder which provides information for users of precision collet chucks.

CIRCUIT BREAKER A 31-page application data leaflet, No. 33-115 which describes the application of power circuit breakers, has been published by Westinghouse Electric & Mfg. Co. The leaflet discusses the method of estimating the short circuit current through a system.

DRAFTING MACHINE Drafto Co., 112 Walnut St., Cochranton, Pa., is circulating a four-page folder which describes a recently developed drafting machine. The folder provides information regarding construction, operation details and prices.

DRILLS AND MINING TOOLS Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. is circulating 64-page Catalog No. 42 which describes a new line of drills, breakers, diggers and associated mining tools. The catalog contains specifications and illustrations of various applications.

DUST CONTROL American Air Filter Co. Inc., Louisville, Ky. has just published an 18-page booklet, "Dust Engineering," which describes the construction and operation of dust control apparatus.

FANS The Emerson Electric Mfg. Co., St. Louis, Mo., offers an eight-page catalog, No. X-4058, illustrating and completely describing the new line of air circulators. The company also offers catalog No. X-4059 which discusses exhaust fans, shutters and protectors of mesh guards, and ventilating equipment. Dimensions, performance and prices are included for all fans.

FURNACES A four-page folder, circulated by Johnson Gas Appliance Company, Cedar Rapids, Iowa describes and illustrates a line of gas furnaces for every industrial purpose; the company builds furnaces to the buyers own specifications.

GAGE BLANKS A revised standard for gage blanks has been released by

Peak production in any working place calls for clear eyes, clear heads and comfortable surroundings. When you get rid of heat, smoke and all the rest, you clear the way for maximum effort, and cut down on chances for errors and dissatisfaction.

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the National Bureau of Standards, Department of Commerce, Washington, D. C., under the title "Gage Blanks, (Third Edition) Commercial Standard CS8-41." This has been accepted by producers and users on the recommendation of the American Gage Design Committee, and with the approval of the Standard Committee. Copies of the 76-page booklet, which sell for 15 cents, may be had by writing to the Bureau of Standards.

HEATING TABLE General Electric Co., Schenectady, N. Y. is circulating a four-page leaflet, No. GEA-3539, which illustrates and describes the application of heating tables.

LUBRICATION Trabon Engineering Corp., 1814 E. 40th St., Cleveland, Ohio, is circulating a four-page folder which illustrates and describes a single pipe system which makes positive forced speed centralized lubrication almost universally applicable.

PLUGGING CONTROL General Electric Co., Schenectady, N. Y., is circulating a four-page leaflet, No. GEA-3571, which illustrates and describes the construction of plugging-control equipment. The leaflet also includes a description of various applications of plugging switches.

NEW BOOKS

RUNNING AN ENGINE LATHE—*By Fred H. Colvin. 117 pages. Published by McGraw-Hill Book Company, 330 W. 42 St., New York. $1.25.*

This book is designed to give the young machinist or apprentice the principles of engine lathe work. The text covers the lathe and its care, how to prepare work and hold it, how to set and use tools, how to do taper work, thread cutting and other operations; all in a simple, step-by-step manner.

Still the most widely used machine tool in the average machine shop, the engine lathe is capable of performing a wide variety of work. In the average shop a knowledge of engine lathe work is essential.

The text of this manual is fully illustrated with line drawings which will help the student quickly to visualize the parts and operations being described. Questions at the end of each chapter are designed to emphasize the material covered.

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FLIGHT—FIRST PRINCIPLES—By *Bailey Wright, James J. Smiley, Jr. and Rex Martin. 288 pages. Published by American Technical Society, Drexel Avenue at 58th Street, Chicago. $2.50.*

Profusely illustrated with 414 drawings and photographs, this book tells for the beginner and the layman the basic principles of aviation. It has been written by practical men with long experience. It begins with a brief history of air transportation, followed by a section giving the language of flying, including all parts of the plane. The theory of flight is discussed in an easily understood fashion. Safety in the air, soaring and parachutes come in for a considerable amount of attention later in the book. Toward the end of the book is a series of quiz questions so that the reader can test himself on the information which he has read. This book, with its companion volume on construction and maintenance, are revisions of the popular material formerly published by the Junior Air Service of America in book and unit lesson form. For those wishing to secure facts and figures about the fundamentals of flight, this book is made to order.

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PLASTICS IN INDUSTRY—*By "Plastes." 241 pages. Published by the Chemical Publishing Co., 236 King St., Brooklyn, N. Y. $5.00.*

Although the authors choose to hide behind the pen name, "Plastes," their presentation makes no secret of the fact that they are British. They wisely avoid extravagant references to the "Age of Plastics" and set about the job of defining legitimate uses of these materials, together with their limitations.

The volume starts logically enough with classifying existing forms of plastics, giving specifications and molding technique in order to set the reader straight as to the fact that plastics constitute a family of materials differing widely in individual characteristics. Then plastics are discussed industry by industry—electrical, aircraft, automobile, building, etc., showing just what they have achieved and what they may hope to achieve in these fields.

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ARSENAL OF DEMOCRACY—*By Burnham Finney, editor, American Machinist. 284 pages. Published by Whittlesey House, 330 West 42 St., New York. $2.50.*

Why does it take so long for America to gear up for the manufacture of armament? Why can't the nation that invented mass production swing its vast facilities into the mass output of guns and tanks and airplanes? Is the delay a result of the orderly process of democracy, a weakness in the very system we are called upon to defend?

Many a layman is asking these questions. The answers are not simple, but they need to be given; and *Arsenal of Democracy* does it.

The man in industry knows something of the job of tooling up. He knows of the plans that must be made, the plants that must be built, the equipment that must be installed and the men that must be trained. He

understands the intricacies that go into this gigantic effort and appreciates the full extent of industry's contribution.

That is not enough. Hundreds of thousands of men and women in this country have never seen the inside of a machine shop. Terms like jigs and machine tools bring no tangible pictures to their minds. But in order to have a nation united behind the twin task of preparing for war and arming Britain, they must understand just what is being done in America's workshops.

Mr. Finney's book tells the layman in his own language what we need and how we are setting about to get it. He describes graphically the vital materials required, the bottlenecks that must be broken and the reasons for the emphasis on machine tools. He explains how the government, the military organization and privately owned plants are working shoulder to shoulder to meet the urgency for wartime equipment.

All these considerations are influenced by means of financing, the supervisory functions of OPM and the impingement of the entire program on civilian life.

A better understanding of what we must do will make us a more cohesive nation and, therefore, a stronger nation. Lack of familiarity with facts has already destroyed the unity of many European nations and brought about their disaster. *Arsenal of Democracy* supplies the facts for America. It will help to bring about that unity of purpose so vital to survival.

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PATENT FUNDAMENTALS—*By Leon H. Amdur, examiner. U. S. Patent office, 305 pages, published by the Chemical Publishing Co., 234 King St., Brooklyn, N.Y. $4.00.*

Probably no other part of our federal law is so often misinterpreted as that dealing with patents. The layman is likely to think that a patent is a license to manufacture the product of his own invention, and he is exceedingly hazy as to what constitutes invention.

Mr. Amdur's book is designed to give a general idea of what patents are all about. The author explains the types of inventions, the nature and classification of patents, the preparation of applications and dealings in patents. All the way through his points are illustrated and emphasized with patents that have been granted or applications that have been refused. The chapter "What Is Invention?" gains its effectiveness from this method of treatment.

The chapter on frivolous patents touches briefly some examples that have caused many a good laugh in patent circles. A chapter dealing particularly with growing plants is inserted because of the 1930 law permitting such patents and the special treatment caused by the unique terminology employed.

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